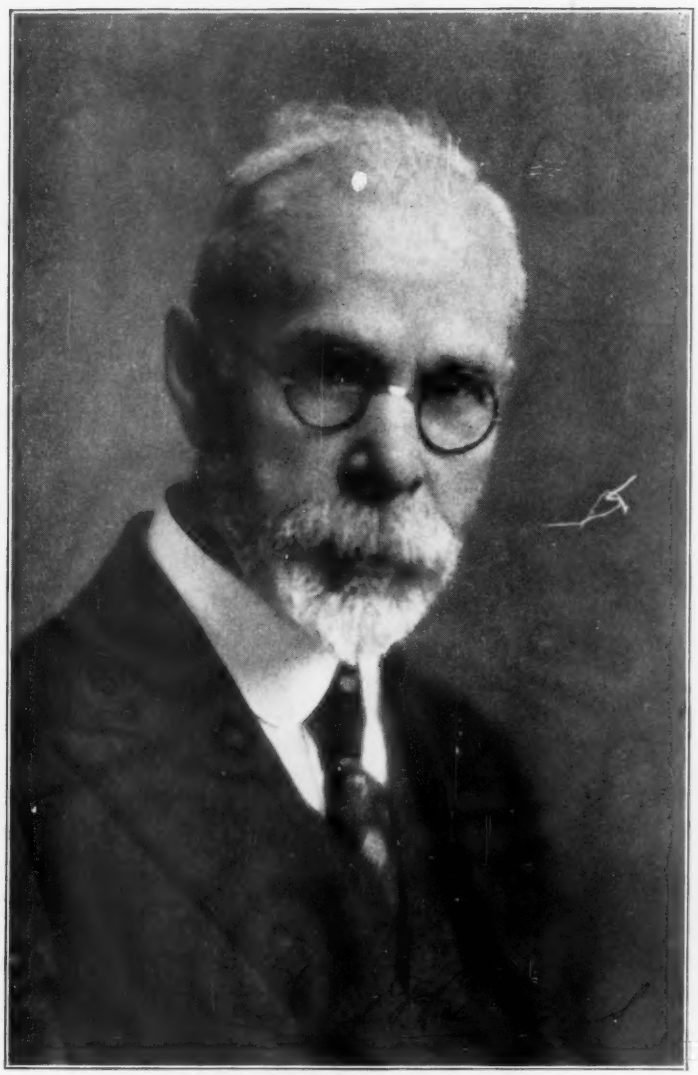
THE BULLETIN

OF THE

AMERICAN CERAMIC SOCIETY

Volume 17 APRIL, 1938 Number 4



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For story, see page 174

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Volume 17 April, 1938 Number 4

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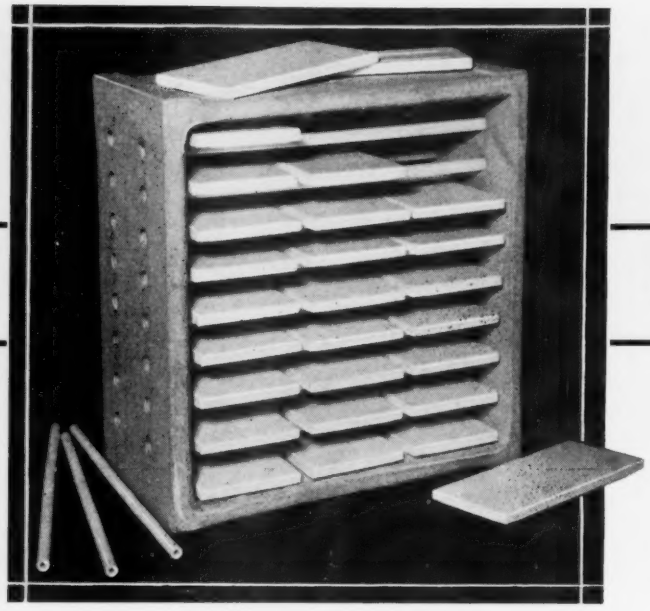

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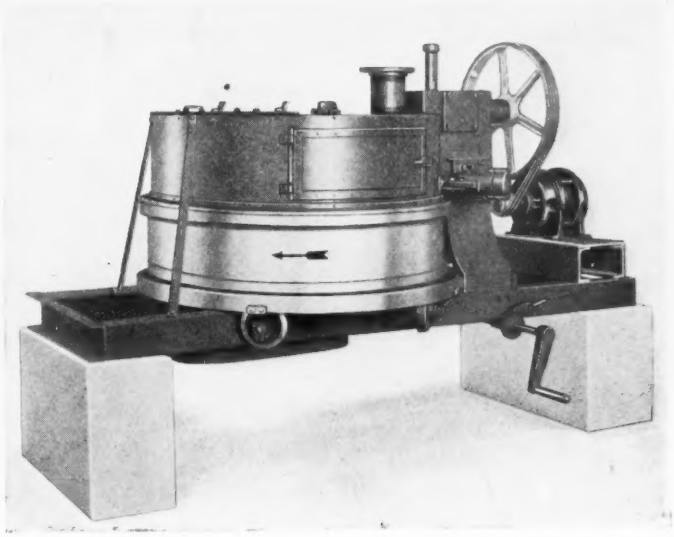

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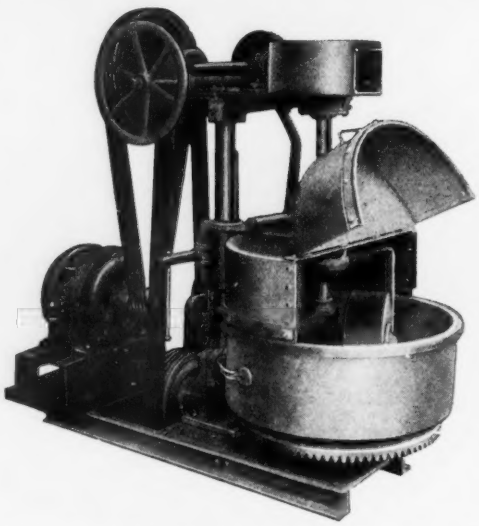

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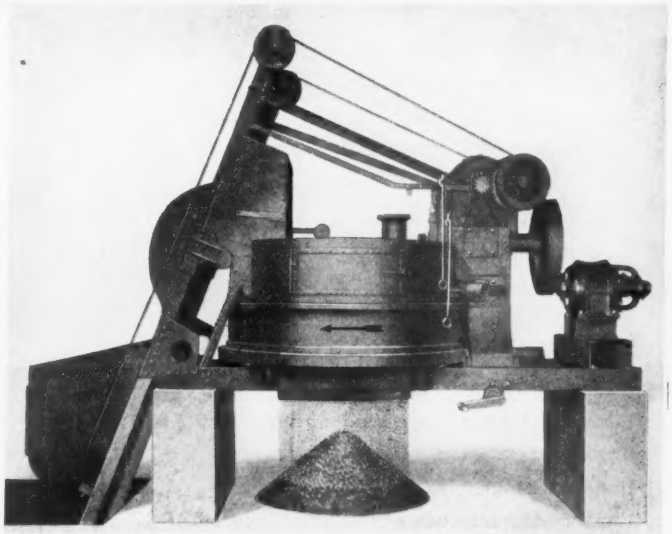

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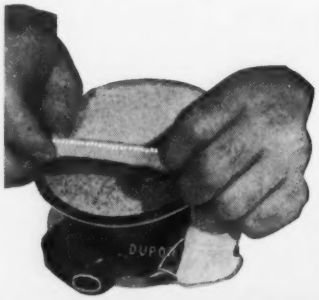

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Clay—Cleaners, Feeders
Lancaster Iron Works, Inc.

Clay (Electrical, Porcelain)
Ceramic Color & Chemical Mfg. Co.
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Kentucky Clay Mining Co.
Newark China Clay Co. Inc.
Old Hickory Clay Co.
Paper Makers Importing Co.
Spinks Clay Co., H. C.
United Clay Mines Corp.

Clay (Enamel)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana Inc.
Kentucky Clay Mining Co.
Metal & Thermit Corp.
Old Hickory Clay Co.
Paper Makers Importing Co.
The Porcelain Enamel & Mfg. Co.
Spinks Clay Co., H. C.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.
United Clay Mines Corp.

Clay (Fire)
Denver Fire Clay Co.
Edgar Brothers Co.
Edgar Plastic Kaolin Co.

New Castle Refractories Co.
Paper Makers Importing Co.
Potters Supply Co.

Clay (German Vallendar)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Kentucky Clay Mining Co.
The Porcelain Enamel & Mfg. Co.
The Vitro Mfg. Co.
United Clay Mines Corp.

Clay Miners
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
Newark China Clay Co. Inc.
Old Hickory Clay Co.
Paper Makers Importing Co.
Spinks Clay Co., H. C.
United Clay Mines Corp.

Clay (Potters)
Denver Fire Clay Co.
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Kentucky Clay Mining Co.
Newark China Clay Co. Inc.
Old Hickory Clay Co.
Paper Makers Importing Co.
Spinks Clay Co., H. C.
United Clay Mines Corp.

Clay (Process Equipment)
Hardinge Company, Inc.
Lancaster Iron Works, Inc.

Clay (Sagger)
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
The Hommel Co., O., Inc.
Kentucky Clay Mining Co.
Old Hickory Clay Co.
Paper Makers Importing Co.
Potters Supply Co.
Spinks Clay Co., H. C.
United Clay Mines Corp.

Clay (Wad)
Kentucky Clay Mining Co.
Potters Supply Co.
Spinks Clay Co., H. C.
United Clay Mines Corp.

Clay (Wall Tile)
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc.
Kentucky Clay Mining Co.
Newark China Clay Co. Inc.
Old Hickory Clay Co.
Paper Makers Importing Co.
Spinks Clay Co., H. C.
United Clay Mines Corp.

Cleaners
Pennsylvania Salt Mfg. Co.
The Porcelain Enamel and Mfg. Co.

Cleaners, Chemical
Harshaw Chemical Co.
Pennsylvania Salt Mfg. Co.

Clocks (Gauge Board)
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.

Cobalt Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
The Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Cobalt Sulphate
Harshaw Chemical Co.

Colors
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
The Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Cones
The Edward Orton, Jr., Ceramic Foundation

Conveying Equipment
Frazier-Simplex, Inc.
Lancaster Iron Works, Inc.

Copper Oxide
Harshaw Chemical Co.

Corhart
Corhart Refractories Co.

Cornwall Stone (Imported)
Consolidated Feldspar Corp.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Eureka Flint & Spar Co.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.

Crucibles (Filter, Melting, Ignition)
Carborundum Co.
Denver Fire Clay Co.
Norton Co.
Potters Supply Co.

Crushers (Clay)
Lancaster Iron Works, Inc.

Cryolite (see Kryolith)
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.
The Vitro Mfg. Co.

Crystolon (Refractory Products)
Norton Co.

Cullet, Washing Plants, Incinerators, Crushers
Frazier-Simplex, Inc.

Decorating Supplies
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Disintegrators
Hardinge Company, Inc.
Lancaster Iron Works, Inc.

Dryer (Pipe Rack)
Lancaster Iron Works, Inc.

Drying Machinery
Frazier-Simplex, Inc.
Hardinge Company, Inc.
Lancaster Iron Works, Inc.
Proctor & Schwartz, Inc.

Electrocast Refractories
Corhart Refractories Co.

Enameling Equipment (Complete)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Frazier-Simplex, Inc.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
The Vitro Mfg. Co.

Enameling Furnaces
Carborundum Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Electro Refractories & Alloys Corp.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Lancaster Iron Works, Inc.
Norton Co.

Enameling Iron (Sheet)
American Rolling Mill Co.
Bethlehem Steel Co.

Enameling Muffles
Bethlehem Steel Co.
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Electro Refractories & Alloys Corp.
Frazier-Simplex, Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Norton Co. (*Alundum*)

Enameling (Practical Service)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Metal & Thermit Corp.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
The Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Enamel Oxide
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Enamels (Porcelain)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Equipment (Porcelain Enameling)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The DeVilbiss Co.
Hardinge Company, Inc.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.

Exhaust Systems
The DeVilbiss Co.

Feldspar
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Eureka Flint & Spar Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Fire Brick
Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Newark China Clay Co., Inc.
Norton Co.
Charles Taylor Sons Co.

Fire Brick—Process Equipment
Lancaster Iron Works, Inc.

Fire Clay
Spinks Clay Co., H. C.

Flint
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Porcelain Enamel and Mfg. Co.

Flint Pebbles
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Consolidated Feldspar Corp.
Eureka Flint & Spar Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
The Vitro Mfg. Co.

Floors (Non-Slip)
Norton Co.

Fluorspar
Harshaw Chemical Co.

French Flint
Consolidated Feldspar Corp.
Eureka Flint & Spar Co.
Paper Makers Importing Co.

Frit
Allied Engineering Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Frosting Mixtures
Harshaw Chemical Co.

Fuel Oil Systems and Control, Stokers
Bethlehem Steel Co.
Frazier-Simplex, Inc.

Furnaces
Allied Engineering Co.
Carborundum Co. (*Carboradiant*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Frazier-Simplex, Inc.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Swindell-Dressler Corp.

Furnaces-Enameling
Swindell-Dressler Corp.

Glass Bending Ovens, Glass Decorating Machines
Frazier-Simplex, Inc.

Glass Equipment
Hartford-Empire Co.
Lancaster Iron Works, Inc.

Glass Melting Tanks and Furnaces
Frazier-Simplex, Inc.

Glass Thickness Gauge
Bausch & Lomb Optical Co.

Glaze and Body Spar
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Du Pont de Nemours, E. I., & Co., Inc. R. & H. Chemicals Dept.
Eureka Flint & Spar Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Glazes and Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Glaze Spar
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Eureka Flint & Spar Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.

Goggles
Cover, H. S.
Willson Products, Inc.

Gold
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. H. & Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Dept.

Gold Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Co.

Granulators
Hardinge Company, Inc.
Lancaster Iron Works, Inc.

Grinding Wheels
Carborundum Co. (*Carborundum and Aloxite*)
Chicago Vitreous Enamel Product Co.
Norton Co. (*Alundum-Crystolon*)

Hearths
Carborundum Co. (*Carbofrax* heat treating)
Corhart Refractories Co.
Electro Refractories & Alloys Corp.
Norton Co. (*Crystolon*)

Hearths (Fused Al_2O_3, SiC)
Electro Refractories & Alloys Corp.

Hearths (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.
Norton Co.

Hose (Air and Fluid)
The DeVilbiss Co.

Hydraulic Propellers
Denison Engineering Co.

Hydrofluoric Acid
Harshaw Chemical Co.

Iron Chromite
Harshaw Chemical Co.

Iron (Enameling)
American Rolling Mill Co.
Bethlehem Steel Co.

Iron Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Kaolin
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
United Clay Mines Corp.
The Vitro Mfg. Co.

Kellog AA Refractories
Electro Refractories & Alloys Corp.

Kilns, China (Decorating)
Allied Engineering Co.
Denver Fire Clay Co.
Drakenfeld & Co., B. F.
Frazier-Simplex, Inc.
The Hommel Co., O., Inc.
Swindell-Dressler Corp.

Kilns-(Electric, Circular, Tunnel)
Allied Engineering Co.
Swindell-Dressler Corp.

Kiln Furniture (Silicon Carbide, Semi-Silicon Carbide) (Refractory)
Electro Refractories & Alloys Corp.
Louthan Mfg. Co.
New Castle Refractories Co.
(P. B. Sillimanite) Charles Taylor Sons Co.

Kyanite
Celo Mines, Inc.

Kryolith (See Cryolite)
Pennsylvania Salt Mfg. Co.

Laboratory Ware
Norton Co.

Lehr Tile (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.
Electro Refractories & Alloys Corp.
New Castle Refractories Co.

Lehrs
Frazier-Simplex Inc.
Swindell-Dressler Corp.

Lehrs (Electric or Fuel Heated)
Frazier-Simplex, Inc.
Swindell-Dressler Corp.

Lehr Loaders
Frazier-Simplex, Inc.

Linings (Furnace Refractory, Block Refractory Plate, Brick and Tile)
Carborundum Co.
Chicago Vitreous Enamel Product Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
New Castle Refractories Co.
Norton Co.
(P. B. Sillimanite) Charles Taylor Sons Co.
The Vitro Mfg. Co.

Lithium Carbonate
Foote Mineral Co.

Lithium Minerals
Foote Mineral Co.

Magnesia (Fused)
Electro Refractories & Alloys Corp.
Norton Co.

Magnesia (Sintered, Calcined)
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Porcelain Enamel and Mfg. Co.

Magnesite
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Magnesite Calcined
Foote Mineral Co.

Magnesium Carbonate
Harshaw Chemical Co.

Manganese
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Manganese Dioxide
Foote Mineral Co.

Manganese (Oxide)
Ceramic Color & Chemical Mfg. Co.
Corhart Refractories Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.

Masks (Breathing)
The DeVilbiss Co.
Willson Products, Inc.

Metals (Porcelain Enameling)
American Rolling Mill Co.
Bethlehem Steel Co.

Microscopes (Polarizing)
Bausch & Lomb Optical Co.

Minerals
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Mixers
Ransome Concrete Machinery Co.

Mixers (Batch)
Lancaster Iron Works, Inc.

Mold Sanders
Lancaster Iron Works, Inc.

Muffles (Furnace)
Allied Engineering Co.
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Frazier-Simplex, Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
New Castle Refractories Co,
Norton Co

Muffles (Laboratory)
Electro Refractories & Alloys Corp.

Mullite (Refractories)
Electro Refractories & Alloys Corp.

Muriatic Acid
Denver Fire Clay Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.

Needle Antimony
Harshaw Chemical Co.

Nickel Salts
Harshaw Chemical Co.

Nitrates (Cobalt, Sodium)
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Nitre
Harshaw Chemical Co.

Non-Gro Refractories
Electro Refractories & Alloys Corp.

Norbide (Norton Boron Carbide)
Norton Co.

Olivine
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Opacifiers
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Metal & Thermit Corp.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Overglaze Colors
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Oxides
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Metal & Thermit Corp.
Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Palladium Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Pins
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Louthan Mfg. Co.
Potters Supply Co.

Pins (Tile Setter)
Louthan Mfg. Co.

Platinum Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Polariscopes
Bausch & Lomb Optical Co.
Frazier-Simplex, Inc.

Porcelain Enameling Service (Practical)
American Rolling Mill Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Hardinge Company, Inc.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Porcelain Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Potash (Carbonate)
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Solvay Sales Corp.
The Vitro Mfg. Co.

Producer Glass Plants
Frazier-Simplex, Inc.

Pug Mills
Lancaster Iron Works, Inc.

Pyrites (Natural Iron Sulphide)
Foote Mineral Co.

Pyrometer Tubes
Carborundum Co.

Electro Refractories & Alloys Corp.
New Castle Refractories Co.
Montgomery Porcelain Products Co.

Pyrometer Tubes (Refractory and Hard Porcelain)
Denver Fire Clay Co.
McDanel Refractory Porcelain Co.
Montgomery Porcelain Products Co.
New Castle Refractories Co.
Norton Co.

Pyrometers (Optical, Radiation, Surface, Immersion, Needle)
Pyrometer Instrument Co.

Pyrometric Cones
The Edward Orton, Jr., Ceramic Foundation

Racks, Firing (Refractory)
Louthan Mfg. Co.

Raw Material Handling Equipment
Frazier-Simplex, Inc.
Lancaster Iron Works, Inc.

Refractometers
Bausch & Lomb Optical Co.

Refractories
Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Louthan Mfg. Co.
New Castle Refractories Co.
Norton Co.
(P.B. Sillimanite) Charles Taylor Sons Co.

Refractory Materials
Carborundum Co.
Chicago Vitreous Enamel Product Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Louthan Mfg. Co.
New Castle Refractories Co.
Norton Co.
Titanium Alloy Mfg. Co.

Represses (Automatic)
Lancaster Iron Works, Inc.

Respirators
Chicago Vitreous Enamel Product Co.
Cover, H. S.
The DeVilbiss Co.
The Hommel Co., O., Inc.
Willson Products, Inc.

Rutile
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Foote Mineral Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Saggers
Carborundum Co.
Electro Refractories & Alloys Corp.
New Castle Refractories Co.
Norton Co.
Potters Supply Co.
Charles Taylor Sons Co.

Salt Cake
American Potash & Chemical Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.

Sandblast Helmets
Willson Products, Inc.

Sand Grinder and Sifters
Lancaster Iron Works, Inc.

Saponin
The Hommel Co., O., Inc.

Selenite of Sodium
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Selenium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Setters (Tableware)
Louthan Mfg. Co.

Sheets (Enameling Iron)
American Rolling Mill Co.
Bethlehem Steel Co.

Silica (Fused)
Electro Refractories & Alloys Corp.
The Hommel Co., O., Inc.

Silicate of Soda
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
The Hommel Co., O., Inc.
Harshaw Chemical Co.

Silicon Carbide
Carborundum Co.
Electro Refractories & Alloys Corp.
New Castle Refractories Co.
Norton Co.

Silicon Carbide Firesand
Carborundum Co.

Sillimanite, P. B.
Charles Taylor Sons Co.

Sillimanite Refractories
Electro Refractories & Alloys Corp.
New Castle Refractories Co.

Slab Pushers—Hydraulic
Denison Engineering Co.

Slabs (Furnace)
Carborundum Co.
Electro Refractories & Alloys Corp
Ingram-Richardson Mfg. Co. of Indiana, Inc.
New Castle Refractories Co.
Norton Co.

Soda Ash
American Potash and Chemical Corp.
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.
Solvay Sales Corp.
The Vitro Mfg. Co.

Sodium Antimonate
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
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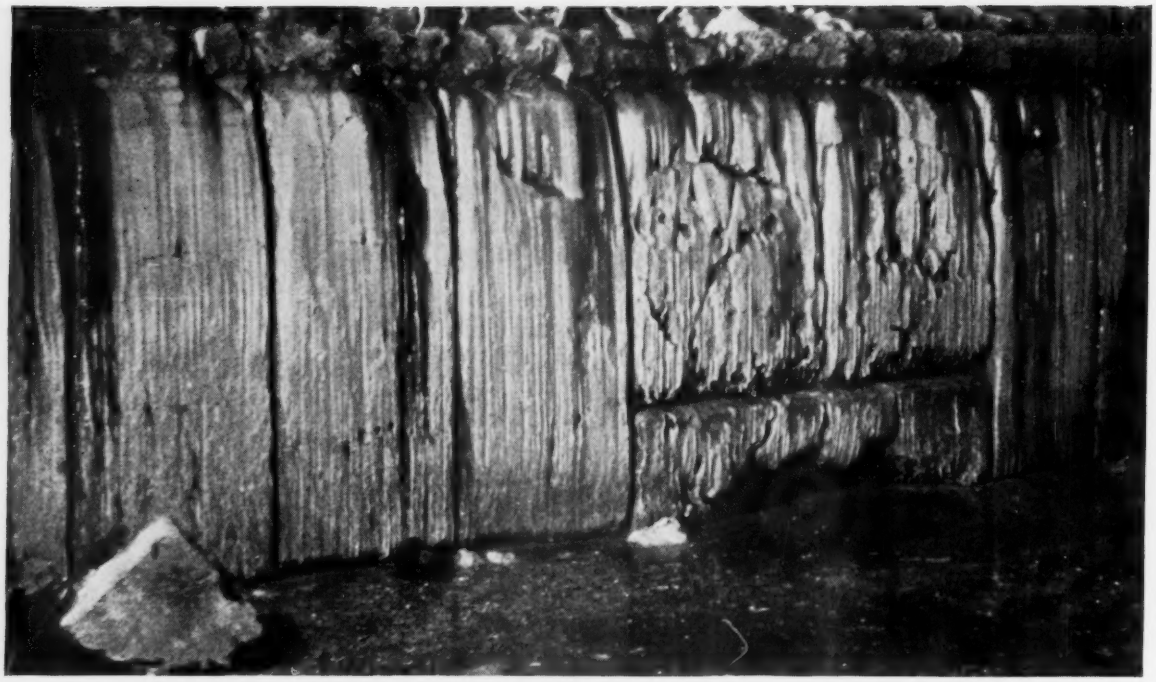

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PAPERS

A CONSIDERATION OF COPPERHEADS*

By L. K. Sosey

Abstract

Copperheads are an ever-present condition, existing in a ground-coat enameling process, that does not appear as a defect until the resistance of the process is decreased to the point where the copperheading tendency is the more powerful and predominates. By the use of various types of pickle, steels, ground coats, furnace atmospheres, and spacings of ware in the furnace, conditions were produced that had varying degrees of resistance to copperheading. Their relative importance in causing or preventing copperheads was studied, and it is shown how a condition on the verge of producing copperheads may be used as a "copperheadometer" to indicate the influence of any change on the ground-coat process and to increase or decrease the process resistance against copperheading.

I. Introduction

In the normal enamel ground-coat firing process, there is an essential oxidation at the surface of the steel sheet. It is also known that the fundamental conditions which produce copperheads in the enamels are the degrees of this oxidation or its localization. Because this oxidation at the surface of the steel sheet is always present in enamel practice, the tendency to produce copperheads in the enamel is also ever present. Copperheading, then, is not a defect but a condition existing in the enameling process that might be compared to the tuberculosis germ existing in the human body, which is present but is not noticed and causes no trouble until the body resistance is decreased to the point where the germ is the more powerful.

In rounding up the fundamental factors which could decrease the enamel resistance to copperheads throughout the ground-coat process, the pioneering days are recalled when, at the sight of copperheads, the enameler turned to the pickle tanks or ground-coat application. If he cleaned the sheets better or, perhaps, gave them a deeper etch or more thorough rinsing or neutralizing, the sheet was ready for a more uniform wetting of the enamel during the firing process and the degree of oxidation was thus under control, *i.e.*, the resistance of the enamel to copperheads was increased at this point. Later, more attention was given to the type of ground-coat frits. Two-frit and then three-frit ground-coat combinations were worked out which gave a faster and more controlled wetting of the enamel on the steel surface during the ground-coat fire; the resistance again was increased. The steel companies also developed better sheets for enameling and increased their resistance against copperheads. The enameler then became conscious of furnace atmosphere as a cause of copperheads, and he vented the furnaces, which in many cases remedied the trouble.

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It would seem that, with all of the present-day improvements in pickling processes, steel sheets, and ground-coat frits, copperheads should have been eliminated from present enameling practices. There are still reports of copperheads, however, and of plants that are said to be on the verge of copperheads. This brings out another cause, the crowding of ware, *i.e.*, spacing the ware too close together during the ground-coat fire. This can be particularly true on a continuous furnace chain which affords the opportunity of crowding the ware as close as possible. Here the resistance of the enameling process to copperheads is decreased because there is an uneven heat distribution on the ware, an uneven wetting of the enamel over the steel surface, and an uncontrolled oxidation. If the degree of decreased resistance caused by the crowded furnace is greater than the amount the resistance has been increased by the better pickling, steel, and ground-coat frit, then the tendency to produce copperheads prevails.

It is the purpose of this study (1) to investigate the conditions that cause copperheading and to determine their relative importance in decreasing the resistance of enamels to copperheads, and (2) to show how the results obtained may be used in overcoming copperheads in plant production.

II. Studies in Ground-Coat Enameling

The following factors in a ground-coat enameling process were studied: varied types of (1) pickling, (2) steel, (3) ground-coat frit or combination of frits, (4) furnace atmosphere, and (5) ware-spacing in furnace.

These factors were varied to produce for each a type condition that would be effective to prevent copperheads and then a condition that would have a tendency to produce them.

The following variations for each type were developed and used.

(1) Pickle

Type I: A standard pickle process used successfully in the writer's plant consisting of a cleaner, hot cleaner rinse, 7% sulfuric acid, cold acid rinse, 0.3% Na_2O, borax-soda ash neutralizer, and immediate drying of ware after pickle.

Type II: An unorthodox pickle to produce a poor or weak pickle in which the cleaner and acid rinses were omitted; the ware was allowed only a rinse in the neutralizer tank which was weakened to titrate 0.1% Na_2O; following this pickle, the ware was allowed to dry in damp cold air.

(2) Ground Coat

Type I: A regular three-frit combination commercial ground coat.

Type II: A hard combination of two commercial frits used a few years ago by enamel plants.

Type III: An unproved, noncommercial ground-coat frit.

(3) Steel

Type I: A regular stock steel used successfully in this plant.

Type II: A steel that under trial had a tendency to copperhead when run in regular ground-coat process.

(4) Furnace Atmosphere

Type I: Using an inclined hair-pin type electric continuous furnace with a vent opening in the top; this vent was on the ingoing side about one-third of the way in the firing chamber. When the box furnace was used, the door was open one foot from the bottom during firing.

Type II: Using the continuous furnace with the vent closed; using the box-type furnace with the door closed.

(5) Ware Spacing

Type I: Single test plates hung on a continuous furnace basket at 6-foot spacing, *i.e.*, plates were spaced 6 feet with no other ware between.

Type II: Test plate hung on a continuous furnace basket with 43 square feet of other ware per 6 feet of furnace chain; the customary furnace spacing in this plant consists of furnace baskets at 6-foot centers with an interior refrigerator liner on each end of the basket with two interior doors hanging in between them; in this type spacing, the test plate took the place of an interior door.

Type III: Test plate hung on a loaded basket between the two interior doors in the setup explained in type II; this gave 50 square feet of ware per 6 feet of furnace chain and made a severely crowded test; the interior doors were moved 1 inch toward the center of the basket and the test plate.

Type B: Firing test plate on pin bars in an electric box furnace with a slow comeback; regular load of ware in the furnace at the time.

Sheet-metal test plates, 12 by 12 inches, were run through a ground-coat process, using these varying type conditions in the following manner of series and combinations:

Type

P1	Pickle { I		F1	Furnace atmosphere { I	
P2	II		F2	II	
S1	Steel { I		H1		
S2	II		H2	Spacing { I	
G1		I	H3	II	
G2	Ground coat {	II	HB	Box-furnace firing	III
G3		III			

SERIES I: VARYING PICKLE AND ONE OTHER FACTOR

Pickle — Degree of copperheading*

P1	S1	G1	F1	H1	None
P2	"	"	"	"	°°†

(The copperhead spots from the poor pickle were due to foreign material.)

Pickle steel

P1	S2	G1	F1	H1	None
P2	"	"	"	"	°°

(The poorer grade steel caused no more trouble than the regular steel.)

Pickle ground coat

P1	S1	G2	F1	H1	None
P2	"	"	"	"	°°°
P1	"	G3	"	"	None
P2	"	"	"	"	°°°°°

(The weaker ground coats were run without indications of copperheading when the other factors were strong in resistance; in combination with the poor pickle, however, an increase in spot copperheads was evidenced.)

Pickle furnace atmosphere

P1	S1	G1	F2	H1	None
P2	"	"	"	"	°°

(The furnace atmosphere had no effect with only the pickle as a variable factor.)

Pickle ware spacing

P1	S1	G1	F1	H2	None
P2	"	"	"	"	——‡
P1	"	"	"	H3	None
P2	"	"	"	"	———
P1	"	"	"	HB	None
P2	"	"	"	"	—

(The more crowded the ware spacing the greater the increase in tendency to copperhead; these conditions also mark the first appearance of the rash-type copperheads.)

SERIES II: VARYING STEEL AND ONE OTHER FACTOR

Steel

P1	S1	G1	F1	H1	None
"	S2	"	"	"	"

(The poor steel did not copperhead with all other factors strong.)

Steel pickle

P1	S1	G1	F1	H1	"
P2	"	"	"	"	°°
P1	S2	"	"	"	None
P2	"	"	"	"	°°

(The weak pickle had no more effect on the poor steel than on the regular steel.)

Steel ground coat

P1	S1	G2	F1	H1	None
"	S2	"	"	"	—
"	S1	G3	"	"	None
"	S2	"	"	"	——

(The weakest ground coat lowered the resistance a little too much when in combination with the poor steel.)

Steel furnace atmosphere

P1	S1	G1	F2	H1	None
"	S2	"	"	"	"

(Furnace atmosphere had little or no effect on either type steel with all other factors strong.)

Steel ware spacing

P1	S1	G1	F1	H2	"
"	S2	"	"	"	——
"	S1	"	"	H3	None
"	S2	"	"	"	———
"	S1	"	"	HB	None
"	S2	"	"	"	——

(Once again, by decreasing the resistance with close-ware spacing any other weak factor is shown up.)

SERIES III: VARYING GROUND COAT AND ONE OTHER FACTOR

Ground-coat pickle

See Series I

Ground-coat steel

See Series II

Ground-coat furnace atmosphere

P1	S1	G1	F1	H1	None
"	"	G2	"	"	"
"	"	G3	"	"	"
"	"	G1	F2	"	"
"	"	G2	"	"	"
"	"	G3	"	"	"

(As in series II, the furnace atmosphere played no part in producing copperheads even in the case of the weakest ground coat as long as all other factors were strong.)

Ground-coat ware spacing

P1	S1	G1	F1	H1	"
"	"	G2	"	"	"
"	"	G3	"	"	"
"	"	G1	"	H2	"
"	"	G2	"	"	—
"	"	G3	"	"	——
"	"	G1	"	H3	None
"	"	G2	"	"	——
"	"	G3	"	"	———
"	"	G1	"	HB	None
"	"	G2	"	"	——
"	"	G3	"	"	——

(With all other conditions favorable any of the ground coats could be run without copperheads, but as the resistance was decreased by closer ware spacing the relative weakness of the ground coats was evidenced.)

* Added circles or increased length of line indicates increased copperheading.

† °, degree of spot copperheads.

‡ —, degree of rash copperheads.

SERIES IV: VARYING FURNACE ATMOSPHERE AND ONE OTHER FACTOR

The furnace atmosphere was varied with the pickle, steel, and ground coat in series I, II, and III, and had no effect as a variable factor in decreasing the resistance of the process to copperheads.

Furnace atmosphere and ware spacing					
P1	S1	G1	F1	H1	None
"	"	"	F2	"	"
"	"	"	F1	H2	"
"	"	"	F2	"	—
"	"	"	F1	H3	None
"	"	"	F2	"	———
"	"	"	F1	HB	None
"	"	"	F2	"	"

(Here the furnace atmosphere shows up for the first time as an actual variable factor. To explain this, it is to be assumed that the type II (F2) furnace atmosphere is not a bad atmosphere from the standpoint of its water-vapor or gas content but as a variable factor of heat distribution. When the vent on the continuous furnace was opened to give F1, it aided in the convection of heat through the ware. In reality the factor, ware spacing, is a heat-distribution problem and F1 and F2 are closely related to it and are effective only when used in combination with it.)

SERIES V: VARYING WARE SPACING AND ONE OTHER FACTOR

These results are shown in series IV where H1, H2, H3, and HB have been used in combination with one of each of the other factors.

SERIES VI: THREE VARIABLES

P2	S2	G2	F1	H1	○○○○_____
"	"	G3	"	"	○○○○○_____
P1	"	G2	F2	"	_____
"	"	G3	"	"	_____
"	"	G2	F1	H2	_____
"	"	G3	"	"	_____
"	"	G2	"	H3	_____
"	"	G3	"	"	_____
"	S1	G2	F2	H2	_____
"	"	G3	"	"	_____
"	"	G2	"	H3	_____
"	"	G3	"	"	_____

(With three conditions varied from the normal, there was an unmeasurable degree of copperheading, indicating that the resistance had been so lowered that it was entirely out of control.)

III. Results

In the first five series, when only one factor was varied, no copperheads were produced except for a few spots caused by foreign material on the surface of the steel sheet in the case of the poor pickle. Any of these factors would have to be unreasonably poor or unorthodox to produce copperheads by themselves in a ground-coat process.

With two variables used, the tendency of the process was on the copperheading side in proportion to the degree of weakness of the factors involved. In the cases in which close spacing was used in combination with one of the other factors, the degree of copperheading was greater than with any combination of any other two variables.

It was also noticed that the type II steel (S2) in combination with closely spaced ware gave a bad copperheading tendency. It was found, in a later investigation that the type I pickle (P1) was not a strong pickle for this steel, and thus the factors (P1, S2, G1, F1, H3) might enter a three-variable combination. A special pickle treatment was given this steel and was so well suited to it that the condition (P (special) S2, G1, F1, and H3), a two-variable condition, did not produce copperheads. This indicated that the special pickle treatment had changed the steel from a copperheading stock to a first-grade steel and that the combination (P (special) S2) was stronger in resistance than (P1, S1).

To continue the investigation, a series was run using three variable factors in combinations.

This series of experiments may help to explain why one plant has had to change its ground-coat frit combination to overcome copperheading when it had previously run for a period with no indications of trouble. The reason probably is that a change had been made elsewhere in the process, that had decreased its resistance, and in order to compensate for this a ground-coat combination with higher resistance had to be used.

(1) The "Copperheadometer"

A plant with ware on the verge of copperheads is one whose process resistance is just hanging in balance. In this case, although the ground-coat process is kept the same and under control day after day, there are unaccounted-for times when a copperheading condition develops. There is probably a slight slip-up in their process and because copperhead resistance is just on the border line, this slight uncontrollable change is enough to throw the process on the copperheading side.

This plant found such a condition when a change was made to a new crowded furnace loading. At first every effort was used not to change the materials or processes, for there was no trouble in the

general run of ware. Then, at times the copperhead rash would show up for no accountable reason; in many cases it was so slight that it was mistaken for steel grit until proved by microscopic investigation to be copperheads. During such time it was noticed that the rash could be thrown from one piece of ware to another next to it by a slight alteration of position on the furnace basket. From this came the realization that here was a condition that could be used as a "copperheadometer," and it led to the series of experiments described here which have shown that with this severely crowded spacing condition any weakness in the ground-coat process is evidenced by resulting copperheads.

To make use of the copperheadometer, each factor of variable resistance in the ground-coat process was attacked and developed to the degree of possible maximum resistance. Starting with the pickle, the combination (P1, G2, S1, E1, H3) was used because (P1), the standard pickle practice, produced copperheads under the close spacing (H3). Many various pickle practices were tried and put to this test and a pickle setup, stronger in resistance to copperheads than the regular practice, was found.

In attacking the ground-coat problem, the combination (P1, G1, S1, F2, H3) was used and a combination ground coat was found that had a better resistance than the regular ground coat. Thus through the process each factor was increased in resistance to copperheads until the once hovering shadow of copperheads disappeared.

Sbegeb Refrigerator Company
St. Paul, Minnesota

COPPERHEADING*

By H. C. Beasley

Abstract

Copperheading is caused by water in milled enamel not being alkaline. The furnace atmosphere seems to aggravate oxidation which results in copperheading. The rate of heating during primary boil is the chief cause of copperheading.

I. Introduction

Copperheading comes from an excess oxidation of the iron which usually occurs in a spotty formation and forms in such an excessive amount that the enamel can not absorb and distribute it. This fires through the enamel leaving an oxidized iron spot of a copper color which has been termed a "copperhead."

There is no question but that certain lots of enameling iron will copperhead more readily than other lots of iron. This happens to all makes of iron. It is also true that some ground-coat frits will copperhead more readily than others.

It is not the purpose of this paper, however, to discuss either iron or frits in regard to this condition, but the study will try to point out to the men in charge of enamel plants the causes of copperheading and its remedies, regardless of its causes. It should be emphasized, however, that copperheading may be due to conditions in the plant or to surface conditions of the iron.

Copperheading comes from two principal causes as follows: (1) by the excess spotty oxidation of the iron that takes place in the evaporation of water from the ground-coat enamel during the drying process; this condition is found on dried ground-coat pieces of ware that have been washed off and allowed to air-dry; small rust spots will occur which were started in the drying of the ground-coat enamel, and when there is an excessive number they may fire through as copperheads; (2) in firing ground coats under certain furnace heating and atmospheric conditions, if the primary boil stage is held at a low temperature too long, excessive oxidation will take place and copperheading will result.

Some of the conditions that are conducive to copperheading are given in detail below.

II. Conditions Which Cause Copperheading

(1) Pickling

Pickling is naturally an important factor in the control of copperheading. If a certain lot of enameling iron has a tendency to copperhead easily, the way the iron is pickled will either aggravate or help this condition. In one plant,

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excessive copperheading was found on a particular lot of iron; in fact, this entire lot of steel was used for one item, which was the only one on which copperheading occurred. The normal time in the acid was fifteen minutes; it was found that by increasing the time in the acid to thirty-five minutes, the copperheading was stopped. In another plant, copperheading was eliminated by reducing the time in the acid from twenty to ten minutes. In the first case, the surface of the iron was such that oxidation took place readily, and overpickling cured this condition. In the second case, the surface condition of the iron was probably such that it did not oxidize readily, but overpickling caused this condition.

In view of these examples, is it any wonder that when enamelers get together they can never agree as to what really is the proper time in the acid?

It is, of course, important that all acid be removed from the iron after pickling, for the acid will naturally aggravate the oxidation of the iron from the water in the ground-coat enamel. This means that the iron should be neutralized and dried properly. Many plants are now using a hot-water rinse after the acid, and one plant uses a boiling-water rinse. It is claimed that this insures the removal of acid from the pores of the iron.

(2) Copperheading from Water

(*a*) *The Water Used:* Each plant should study the water that is used. This study will indicate the particular mill addition to be used and also the length of time the ground coat should be aged before using. Some waters will dissolve alkali more readily than others, and the water in the ground-coat enamel should be alkaline to prevent copperheading.

(*b*) *New Enamel:* If the enamel is used too fresh from the mill, *i.e.*, the water has not had time to dissolve alkali from the frit and mill additions, it will be more apt to copperhead. This is more likely to occur in the winter when this solution of alkali is slow, owing to the cold enamel. The remedy, when only new enamel is available, is to heat part of the fresh enamel to approximately 90°F which will age the enamel quickly and make the water alkaline. It is suggested that only half of the enamel be heated to prevent overaging and draining trouble.

The author does not believe that mills should be water-cooled in the winter unless they are known to run excessively hot or unless the enamel is stored in a warm place. Although the mills are cooled in the summer to keep the enamel from becoming too hot and overaging quickly, thereby causing draining troubles, in the winter underaging of the enamel may occur.

(*c*) *Addition of Water to the Dip Tank:* If the enamel in the dip tank becomes heavy, making it necessary to add an excess amount of fresh water, this water (not being alkaline) may not be mixed properly with the enamel and may cause rusting of the iron which would result in copperheads. The remedy for this is to get the proper dipping weight by the addition of thin aged enamel to the tank instead of fresh water.

(*d*) *Adding Water to the Mill:* It is necessary that the proper amount of water always be added to the mill for milling the ground coat. The enamel must not be too thin, but enough water should be added in the mill charge to make unnecessary further excessive water addition to the mill in order to discharge the enamel after milling. Too much fresh water will have the same effect as mentioned.

(3) Loss of Fine Enamel from the Dip Tank

Practically all ground-coat enamels in use on flatware are composed of two different frits. One is a hard member, the other is soft. In milling the soft frit grinds finer than the hard. If a dip tank is used for any great length of time without adding any fresh enamel, it is possible to remove a larger percentage of the soft enamel than the hard, because hard enamel, which is coarser, has more of a tendency to roll off during draining. The resultant enamel will copperhead more readily than one that has the proper proportion of soft enamel in it, although copperheading from this source usually occurs in combination with some other cause. In a certain plant, for example, copperheading would occur several hours after dipping from the tank. The remedy used was not to fill the tank so full and to add enamel to the tank every few hours. It was discovered later, however, that the main cause of this trouble was due to the furnace.

(4) Copperheading from Heating Rate

As was pointed out earlier, when the enamel starts to absorb iron oxide it does so in a multi-

plicity of spots. If, in the early stage of firing (when the primary boil occurs) the heating is done at a very slow rate, the primary boil stage is prolonged and excess oxidation will occur, which may fire through as copperheads. This condition occurs by a large percentage more often in continuous furnaces than in box-type furnaces. In the latter, it is usually a question of adjusting the firing cycle properly. A continuous furnace is more of a problem because a large part of the preheating is accomplished by hot air coming out of the firing chamber, and this amount of hot air depends on the amount of cold air taken in at the bottom of the preheating chamber entrance. This causes more copperheading on continuous furnaces in the winter than in the summer, because the air is colder in winter and there is more draft on the preheat entrance. This can usually be adjusted by having more baffling of the entrance of the cold air to the furnace in the winter than is done in the summer.

It will also be found that varying the amount of ware that is run in the furnace will cause copperheading, *i.e.*, the more ware loaded on certain types of furnaces the greater the possibility of copperheading. The heavy load of ware slows down the heating rate and prolongs the primary boiling stage. This causes excess oxidation which burns through as copperheads.

In box-type furnaces, copperheads are more apt to occur on hanging loads than on flat loads. If a large hanging load is run into a furnace on which the temperature is slow in coming back, the primary heating stage will be lengthened and will cause copperheading. This condition, of course, may happen on flat loads in a box-type furnace, but it would have to be an extremely slow furnace or an unusually heavy load of furnace tools to bring it about, for on flat loads the ware is close to the bottom of the furnace where the heat transfer is usually fast.

In a continuous furnace, the primary boil usually starts in the preheating zone and is completed in the first part of the heating chamber. If the lead on the chain is appreciably increased, the primary boil may start at approximately the same place, but owing to the excess weight of material that has to be heated up, it may not be completed in the usual time, which of course means that the primary boil stage was of such duration that excess oxidation took place which resulted in copperheading.

(5) Atmospheric Conditions in Furnace

The presence of any gas in the furnace that will attack the iron during the primary boil will also cause copperheading. Sulfur is probably the most damaging, and it is for this reason the sulfur in the fuels must be controlled. It has been found that the presence of CO_2 alone did not appreciably affect copperheading.

Excess water-vapor in the furnace atmosphere is conducive to copperheading and should be guarded against. It usually occurs in hot weather when the humidity is high. High humidity affects the furnace atmosphere in two ways. The draft on the stack of fuel-fired furnaces is relatively slight, a condition which allows more products of combustion to go through cracks in the muffle. Owing to the high humidity of the atmosphere in the room, the necessary change of air in the muffle is not obtained. In other words, the furnace chamber is not scavenged properly. The latter is true of all types of furnaces, either fuel-fired or electric.

III. Conclusions

Someone may say that if all of the different things pointed out cause copperheading it would be almost impossible to run a plant without copperheading. Copperheading, however, would never occur from *any one cause* discussed, unless it is improper rate of heating. Like a lot of other trouble that occurs in enamel plants, it is usually a combination of several things that brings on copperheading. It may be that 90% of the practices in a plant are correct, but the *one* thing that goes wrong at certain times might be causing copperheading. It is possible that in some plants it is not necessary to check on even one-half of the causes pointed out, for the furnace conditions may be such that some of the things that cause one plant difficulty would not affect another plant. The writer, however, feels that it is necessary to point out some of the chief things that would contribute to copperheading in order to cover general plant conditions.

It was pointed out at the beginning of this article that enameling iron varies and that some lots of iron will copperhead while others will not. Each plant can study its own operating conditions to take care of this problem except in extreme cases. For example, a stove plant definitely proved that the particular iron being used copperheaded, whereas the iron received

previously did not copperhead; twenty-five stoves made out of the iron that copperheaded were sent to another enamel plant to be enameled. This plant enameled these stoves without any sign of copperheading. Another plant was in and out of copperheading trouble over a long period of time. One steel mill that was supplying the enameling iron had received numerous complaints. The mill took several heats of sheets that were ready for shipment, divided them into two lots, shipped half to the plant which reported copperheading when they were used. The other half was shipped to another plant that reported no copperheading from this lot of iron. This illustrates how conditions in individual plants may vary and affect copperheading.

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A DISCUSSION ON COPPERHEADING OF SHEET-STEEL GROUND COATS*

By T. D. Hartshorn

ABSTRACT

Various causes of copperheading are listed from plant observations by the writer. Copperheads may be controlled by observing the following suggestions: avoid blistering conditions; use ground-coat compositions with high iron-oxide solubility, low viscosity, and ability to form a protective seal quickly; maintain proper firing conditions; and use the nickel dip.

I. Introduction

The fact that copperheading of sheet-steel ground-coat enamels has been chosen as a discussion subject by the Program Committee indicates that it is still a source of difficulty in spite of the rather large amount of information available.

Copperheads appear in the fired enamel as spots of oxidized iron and slag not covered with enamel. Some blistering or boiling of the ground coat seems necessary to produce them. In this discussion it may be of advantage to consider some of the published information on this subject.

(1) Literature Review

Cooke[1] reported a blistering of ground-coat enamel when fired in atmospheres of nitrogen or carbon dioxide or of insufficient oxygen.

Fusselbaugh[2] found that "an increase of sodium oxide at the expense of boric oxide increased the tendency toward the formation of copperheads. Conversely, the increase of boric oxide at the expense of sodium oxide decreased the tendency to copperhead."

According to Geisinger and Berlinghof,[3] fine copper spots developed on ground-coat samples fired in an oxygen atmosphere and blisters formed in atmospheres of hydrogen, steam, chlorine, hydrogen sulfide, ammonia, and coal gas.

Andrews and Hertzell[4] reported blistering and copperheading of ground coats when fired in a furnace containing city gas and blistering in an atmosphere of nitrogen or carbon dioxide.

Schaal and Fuller[5] found a direct relation between primary boiling of ground coats and copperheading. They concluded that "on pieces of ground-coated steel, where there is no primary boiling, there is also no copperheading."

Schaal[6] reported a definite copperheading tendency of steels which show the presence of pearlite areas after the ground-coat firing. In the same paper, he demonstrated the value of the blended or two-frit ground coat in overcoming copperheading by lowering the enamel viscosity.

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* Presented at the Thirty-Ninth Annual Meeting, American Ceramic Society, New York, N. Y., March 24, 1937 (Enamel Division).

[1] R. D. Cooke, "Effect of Furnace Atmosphere on Firing Enamel," *Jour. Amer. Ceram. Soc.*, **7** [4] 277–81 (1924).

[2] R. R. Fusselbaugh, "Some Effects of Varying Soda and Boric Oxides in Ground-Coat Enamels," *ibid.*, **10** [4] 270–74 (1927).

[3] E. E. Geisinger and K. Berlinghof, "Effect of Furnace Gases upon Glass Enamels," *ibid.*, **13** [2] 126–42 (1930).

[4] A. I. Andrews and E. A. Hertzell, "Progress Report on the Effect of Furnace Gases on the Quality of Enamels," *ibid.*, **13** [8] 522–29 (1930).

[5] R. B. Schaal and D. H. Fuller, "Discussion on a Mechanism of Black Speck Formation in Enamel Resulting from Reboiling of the Ground Coat," *ibid.*, **15** [6] 344–51 (1932).

[6] R. B. Schaal, "Sheet-Iron Enamels," *ibid.*, **15** [9] 490–94 (1932).

Danielson and Tetrick[7] showed the greater tendency of viscous ground coats to develop copperheads. They also demonstrated that Staley's calculated refractory value may be used to predict the viscosity of normal enamels.

A paper by Porst and Wolfram[8] indicated that a delay in enameling sheet steel after pickling promoted copperheading. This was more pronounced with viscous single-frit enamels.

Ebright, McIntyre, and Irwin[9] found that copperheading may result from an improper furnace atmosphere and from excessive metal oxidation caused by too slow a firing rate in the early stages.

Hansen and Irwin[10] described the use of a nickel dip as a remedy for copperheads. A thin deposit of nickel over steel seems to be advantageous in preventing excessive oxidation.

Cook[11] concluded that the box-type furnaces showed less copperheading than continuous furnaces, probably owing to the shorter firing period. He also reported that shorter pickling time and the use of a sodium cyanide neutralizer decreased copperheading.

Martin[12] reported a departure from the customary method of firing ground coats which resulted in the elimination of copperheads. Unfired ground-coated shapes are oxidized at approximately 1000°F in a normal atmosphere, and the fusing of the enamel is then accomplished in a controlled nonoxidizing atmosphere at the proper temperature.

II. Observations on Copperheading

The writer's experience contributes the following observations:

(1) Some grades of japanning stock show a decided tendency to blister and to copperhead more than some enameling stock.

(2) A nickel dip is beneficial to decrease copperheading.

(3) Poor set of ground-coat slip, coarse grinding, thin coating, and overfiring tend to increase copperheading.

(4) Ground-coat compositions for flatwork have been softened in recent years to permit lower firing temperatures and to lessen warpage. Any change which decreases the glass-forming acid constituents and increases the alkalis appears to lessen the solubility of iron oxide in the enamel and increases copperheading. This same effect is found in leadless cast-iron cover enamels used on cast iron without a ground coat. Those compositions which are low in the acid constituents develop a defect which is similar to copperheading in sheet-steel ground coats.

(5) The addition of a small amount of soft ground coat to the regular enamel gave a blended ground which eliminated the copperheading on the japanning stock, referred to in (1).

(6) A full muffle, oil-fired, box-type furnace, used to fire the ground coat, showed periods of copperheading. Improvement in this condition always followed the repair of leaks in the muffle.

(7) Ground coat fired in a continuous U-type electric furnace with an elevated firing zone showed copperheads, particularly on upper sections of pieces hung vertically. Improvement in this condition followed venting the furnace and raising the temperature on the ingoing side of the firing zone.

(8) The copperheading season at this plant appears during the summer months. While the prevailing higher temperatures of that season may tend to affect enameling operations, the higher true humidity of summer seems to promote copperheading. The Milwaukee Weather Bureau reports the following conditions:

	Av. temp. (°F)	Av. relative humidity (%)	Water-vapor (grains/cu. ft.)
Winter	23	75	1.06
Summer	68	65	4.86

These figures show that there is an average of more than $4^1/_2$ times as much water-vapor in the local atmosphere in summer as in winter. This same condition prevails with slight variation throughout the eastern and mid-western enameling territory.

Excess water-vapor in the firing atmosphere seems to accelerate the metal oxidation, promoting a copperheading condition. This also ap-

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[7] R. R. Danielson and J. D. Tetrick, "Viscosity and Reboiling of Blue Ground Coats," *Jour. Amer. Ceram. Soc.*, **17** [11] 343–45 (1934).

[8] E. G. Porst and H. G. Wolfram, "Effect of Delay in Enameling Pickled Sheet Iron," *ibid.*, **17** [10] 297–300 (1934).

[9] H. E. Ebright, G. H. McIntyre, and J. T. Irwin, "Study of Furnace Atmospheres and Temperature Gradients and Their Effect on Porcelain Enameling," *ibid.*, **18** [10] 297–302 (1935).

[10] J. E. Hansen and J. T. Irwin, "Use of a Nickel Dip in Enameling Practice," *ibid.*, **18** [8] 225–29 (1935).

[11] H. L. Cook, "How the Continuous Enameling Furnace Affects Copperheads," *Bull. Amer. Ceram. Soc.*, **14** [12] 393–95 (1935).

[12] W. G. Martin, "Oxidation Control for Firing Ground-Coat Enamels," presented at the Thirty-Eighth Annual Meeting, American Ceramic Society (1936).

pears to take place when undried ground coat is conveyed into the furnace. Furthermore, the copperheading in leaking, oil-fired, box-type furnaces may have been caused by water-vapor in the products of combustion rather than by other gases.

III. Conclusions

In general, it appears that the problem of copperheading should be approached from several different angles as follows: (1) avoid conditions which cause excessive blistering; (2) use ground-coat compositions with high iron-oxide solubility, low viscosity, and the ability to form a protective seal quickly; (3) maintain proper firing conditions, including suitable furnace atmosphere and firing cycle; and (4) make use of all possible protective measures, such as the nickel dip.

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ENAMEL CHIPPING: THE RELATIONSHIP OF GROUND-COAT ADHERENCE TO THE THICKNESS AND YIELD VALUE OF SHEET STEEL*

BY GEORGE SIROVY AND E. P. CZOLGOS

ABSTRACT

By means of an Olsen steel tensile-strength testing machine, ground-coated sheet-steel samples of 14, 16, 18, 20, 22, and 24 gages were subjected to tensile stresses. It was noted that ground-coat chipping occurred immediately upon passing the elastic limit of the steel.

I. Introduction

Chipping constitutes one of the most common defects that occur in porcelain enamel manufacture. As an initial investigation of chipping, studies were made on the failure of ground-coat enamel by impact and tensile stresses set up by mechanical external forces affecting both the enamel and the steel.[1]

II. Method of Procedure

This investigation consisted of subjecting ground-coat enameled sheet-steel samples of 14, 16, 18, 20, 22, and 24 gages to the following tests:

(1) Elongation by tensile stresses from an Olsen steel tensile-strength testing machine. The results noted were (*a*) the yield value of the metal of the ground-coat enameled samples of each gage in pounds per square inch, (*b*) the stress in pounds per square inch at the time of enamel fracture, (*c*) comparative type of enamel fracture, and (*d*) percentage of elongation at the time of the enamel fracture.

(2) Crushing by impact without deformation of the steel by a drop-hammer bond-testing machine. The results were noted on (*a*) the type of enamel fracture and (*b*) the comparative degree of enamel fracture.

(3) Crushing by impact with deformation of the steel by a drop-hammer bond-testing machine. The results were noted on (*a*) the depth of steel indentation of samples of each gage and (*b*) the comparative degree and type of fracture of the enameled phases.

III. Description of Test Samples

The sample used for the tests was 2 by 12 inches, with a concave narrowing of the center width to $1^1/_8$ inches for an inner length of 2 inches, the reduction starting $3^1/_4$ inches from each end.

Ground-coat enamel was applied to both faces of the samples by dipping in a ground coat, the consistency of which was set so as to drain to $1^1/_4$ ounces dry enamel per square foot. Before firing, the enamel was brushed away $^1/_8$ inch from each edge to remove any drain beads, and 1 inch from each end.

All samples of similar gage were fired together in an oil-fired box-type furnace at 1560° to 1580°F until the ground coat was mature. The average thickness of the enamel coat, 0.0033 inch, was measured by means of a G. E. magnetic enamel thickness gage.

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* Presented at the Thirty-Eighth Annual Meeting, American Ceramic Society, Columbus, Ohio, March 31, 1936 (Enamel Division).

[1] A. I. Andrews of the University of Illinois demonstrated at an enamel short-course session that ground-coat enamel will fail under tensile stress if the steel is elongated beyond its elastic limit.

IV. Description of Tests

(1) Elongation by Tensile Stresses

The samples were elongated at the rate of 0.05 inch per minute to the elastic limit of the steel and on through to the fracture of the enamel surface. The actual stress in pounds was recorded at the elastic limit of the steel and at the point where enamel fracture took place. The elongation of a 2-inch gage length at the center of the sample was measured. From these data, the percentage of elongation, the tensile strength of the steel, and the stress in pounds per square inch at the time of enamel fracture were calculated.

TABLE I

DATA OF ELONGATION BY TENSILE STRESSES

	Steel gage	Sample thickness (in.)	Cross-section area (sq. in.)	Stresses at yield value (lb.)	Stresses at yield value (lb./sq. in.)	Stresses at enamel fracture (lb.)	Stresses at enamel fracture (lb./sq. in.)
	14			2670		2760	
	14			2670		2840	
	14			2400		2840	
Av.	14	0.0743	0.0902	2580	28,631	2810	31,153
	16			2120		2310	
	16			2030		2230	
	16			1970		2030	
Av.	16	.0598	.0735	2040	27,775	2190	29,796
	18			1640		1840	
	18			1850		1970	
	18			1710		1880	
Av.	18	.0469	.0599	1733	28,999	1897	31,669
	20			1350		1480	
	20			1390		1620	
	20			1340		1580	
Av.	20	.0376	.0490	1363	27,816	1560	31,837
	22			1310		1450	
	22			1290		1370	
	22			1290		1420	
Av.	22	.0331	.0440	1290	29,054	1413	31,824
	24			980		1110	
	24			980		1200	
	24			980		1150	
Av.	24	.0269	.0359	980	27,300	1153	32,116
Av.					28,263		31,399

Elongation at enamel fracture, 0.0625 in. and 3.125%.

(2) Crushing by Impact without Steel Deformation

One end of each sample was subjected to an impact force of 9.52 foot-pounds. The degree and comparative type of enamel fracture was noted.

(3) Crushing by Impact with Steel Deformation

The impact bond-testing machine with an open anvil area of 0.3547 square inch was used for this test. One end of each sample was subjected to an impact force of 9.52 foot-pounds. The depth of steel indentation and the comparative degree and type of enamel fracture was noted.

V. Results of Tests

(1) Elongation by Tensile Stresses

The important result obtained from this test revealed that ground-coat fracture or chipping did not occur until the steel was elongated beyond its elastic limit on all gages. The fractures occurred as short cracks, parallel to each other, and at right angles to the lines of stress. They were first noted in the glass phase and then immediately after in the bond phase. The percentage of elongation at the point of fracture was the same for all gages and was equal to 3.125%.

(2) Impact without Steel Deformation

Equal degree of fracture occurred in all gages. The type of fracture was chiefly a shattering of the glass phase of the ground coat over an area of about 0.0284 square inch. No pronounced fracture of the bond phase or deformation of the steel shape could be detected by eye examination.

TABLE II

IMPACT WITH DEFORMATION OF STEEL

Gage	Total thickness (in.)	Depth of steel indentation (in.)	Total fracture area (sq. in.)	Center fracture: Area (sq. in.)	Center fracture: Glass phase	Center fracture: Bond phase	Circumferential fracture: Area (sq. in.)	Circumferential fracture: Glass phase	Circumferential fracture: Bond phase
14	0.0809	0.024	0.209	0.049	Total	Total	0.160	Total	None
16	.0664	.032	.338	.049	"	Slight	.29	"	"
18	.0535	.044	.335	.049	"	"	.306	"	"
20	.0442	.045	.335	.085	"	"	.270	"	"
22	.0397	.048	.335	.085	"	"	.270	"	"
24	.0335	.050	.335	.110	None	None	.245	"	"

(3) Impact with Steel Deformation

(1) Deformation occurred in all gages. The maximum amount occurred in the thinnest gage, No. 24, decreasing to the least amount in the thickest gage, No. 14.

(2) The minimum amount of total fracture area occurred in the thickest gage, No. 14, increasing in extent in No. 16 gage, with the gage Nos. 18, 20, 22, and 24 equal in extent.

(3) Fracture of the glass phase and slight fracture of the bond occurred in the outer circumferential impact areas in all gages.

(4) The maximum amount of fracture of the glass and the bond occurred in the center of the impact area of the thickest gage and decreased in extent to the thinnest gage. No fracture of either phase occurred in the latter area, because the gage was so thin as to offer little resistance. In the center zone of impact, therefore, a punch action occurs, with the fracture taking place chiefly along the circumferential area where the deformation has taken place. Unless this action is taken into consideration, the result may be misleading.

VI. Conclusions

(1) The results of these tests indicate that ground-coat enamel fractures, caused only by tensile stresses, do not occur until the elastic limit of the steel is exceeded. (The actual stress required to exceed the elastic limit of the steel increases with the thickness of the steel because of the increase in cross-sectional area available to absorb the stresses.)

(2) Ground-coat enamel fractures, caused by equal impact stresses, are comparatively equal in all steel thicknesses, provided the steel is reinforced to prevent deformation of its shape.

(3) Ground-coat fractures, caused by equal impact stresses, decrease in extent with increase in steel thickness, where the steel is allowed to be deformed by the stresses.

Acknowledgment

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BEHAVIOR OF ENAMELS IN CONTACT WITH LIQUIDS AT HIGH TEMPERATURES AND PRESSURES*

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Abstract

The resistance of enamels to the autoclave treatment was much greater than anticipated, and breakdown was very slow, even under severe conditions. Hard ground-coat enamels showed the most promise.

I. Introduction

The suitability of porcelain enamel as a lining for many of the appurtenances used in the drug industry at temperatures and pressures higher than the ordinary has been well known for many years and special enamels have been developed for the purpose. More recently the possibilities of enamels as interior linings for hot-water tanks, boilers, and similar articles for use in the home have been demonstrated. The relatively rapid corrosion of such articles presents a serious problem in many communities. In one locality, it was found that while an ordinary galvanized-iron tank rusted through in two years, an enameled tank showed only slight corrosion after six years, indicating the superior value of the enamel-lined tank as well as the possibilities in this field.

While the above results were indicative of the value of enamel linings in the water-heater equipment, they also revealed the fact that a simulated service test was necessary to test enamels for this use. The manufacturers wished to use an ordinary production enamel rather than a special type, and it became necessary to develop a suitable test as a basis of comparison.

It has been found that galvanic action is probably a major factor in the corrosion of iron water tanks and that any properly enameled surface whereon the metal is completely covered will resist this type of corrosion. Inasmuch as the service requires enamels to be subjected to

* Presented at the Thirty-Ninth Annual Meeting, American Ceramic Society, New York, N. Y., March 23, 1937 (Enamel Division).

water pressures, ranging from 30 to 90 pounds per square inch, and to temperatures around the boiling point in waters of varying composition, it appeared that an autoclave test of some kind might give the best promise of rapid results. The autoclave has been widely used in the pottery industry to determine the growth of wall tile and the craze resistance of glazes. No data, however, upon the behavior of enamels in the autoclave were available.

II. Equipment

A home-made autoclave, consisting (see Fig. 1) of a 12-inch section of 8-inch steel pipe with caps at each end and fitted with a hand hole safety valve and water-outlet valves, was assembled. The apparatus was set up in a horizontal position under a sheet-iron shell designed to give uniform heating to all parts of the chamber. This apparatus was capable of withstanding pressures in excess of 100 pounds per square inch, with sufficient space to test four specimens simultaneously.

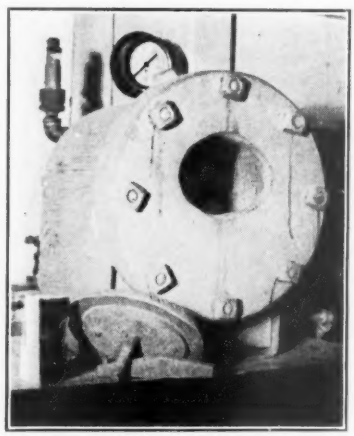

FIG. 1.

NOTE: High-pressure tests were run at the National Bureau of Standards through the courtesy of R. F. Geller. An electrically heated autoclave at pressures of 300 lb. per sq. in. was used.

III. Methods and Procedure

Enamels under test were applied in the regular way (ground coats dipped at 35 g./sq. ft. dry weight and cover coats applied over ground coats at 65 g./sq. ft.) over 20-gage enameling iron test plates, fired, and cut into 2- by 4-inch test strips. The strips were placed in 200 cubic centimeter Pyrex-brand beakers, containing the test media, and these were set inside of the autoclave, the lower portions of the beakers being partially immersed in the water of the autoclave.

In the case of the high-pressure test, the strips were immersed in tap water in the autoclave chamber itself, inasmuch as it is believed by some authorities that the beaker glass might seriously disintegrate at the pressure used. Temperature and pressure in the autoclave were raised as rapidly as possible to the test pressure, the time of test being taken as the total time the specimens were subjected to the test pressure. Temperatures attained at various steam pressures in a sealed chamber are shown in Table I.

TABLE I
TEMPERATURE-PRESSURE RELATIONSHIP

Temp. (°F)	Pressure (lb./in.²)
260	35
280	50
308	75
320	90
420	300

(1) Enamels Tested

Table II shows the enamels tested. In the preliminary tests, a number of enamels of each of the several generally known types of sheet-steel enamels were tested. In the final tests, enamels A1, A4, B1, D1, and D3 were tested, inasmuch as these enamels seemed to cover the field satisfactorily. All enamels used were leadless.

A firing-range series of these enamels was made in an attempt to ascertain the effect of firing treatment upon attack. The series was fired as shown in Table III.

TABLE II
ENAMELS TESTED

Piece No.	Enamel type
A1	Single glass ground coat (hard)
A2	" " " " (moderately hard)
A3	" " " " (special composition)
A4	Three glass ground coat
B1	Opaque acid resisting
B2	Super-opaque acid resisting
C1	Opaque cover coat
C2	" " "
C3	Clear cover coat

TABLE III
FIRING TEMPERATURES FOR FIRING-RANGE SERIES

Enamel	Time (min.)	Temp. (°F)				
A1	4	1600	1555	1510	1450	
A1	10	1600				
B1	2	1600	1550	1525	1475	1425
C1	2	1600	1550	1500	1450	1400
C3	2	1600	1550	1500	1450	1400

(2) Effect of Increased Pressure

Tests were run at 60, 90, and 300 pounds per square inch.

(3) Effect of Time

Tests were run for 3, 4, 8, 16, and 24 hours' duration. The high-pressure test was run for three hours and the 60 pounds pressure for 4 and 8 hours.

(4) Effect of Electrolytes

Tests were run with tap water, distilled water, 100, 500, and 1500 parts per million of Na_2CO_3; 100, 500, and 1500 parts per million of H_2SO_4; and 500 parts per million of borax for the various times at 90 pounds per square inch pressure.

(5) Final Simulated Service Test

The most promising tests were combined to give a simulated service test.

IV. Results

(1) Enamels

Ground coats, on the whole, show a greater resistance to the autoclave test than the others. Enamel A1 showed the best of this class of enamels, and A4 the worst. Acid-resistant enamels

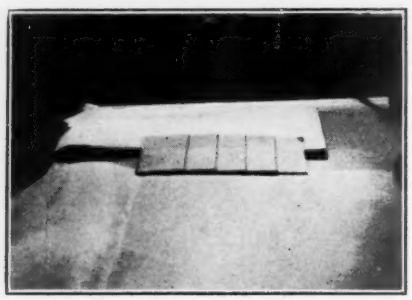

FIG. 2.

show next best resistance with opaque cover coats next, and clear cover coats the least resistant. All of the enamels showed considerably better resistance when given a hard fire than when underfired. When underfired, the normal tendency to fishscale was greatly aggravated. Even cover-coat enamels, which ordinarily are made to fishscale with some difficulty, when underfired, showed this tendency. The hard-fired acid-resistant enamels showed resistances nearly as good as the ground coats, but, owing to the tendency of this type of enamel to pit when overfired, they are not recommended. Figure 2 shows the effect of firing temperature on enamel C1, ranging from low temperature on the right to high on the left.

The enamels in no case actually broke down, except when the acid electrolyte was used on the cover-coat enamels. There was, however, a discoloration and etching of the surface, which gave an easily comparable index of the resistance of the enamel. In some cases, the ground coats showed a slight surface discoloration but no etching. It would appear that an extremely severe autoclave treatment, involving both high pressure and long duration, would be required to break down most of the enamels tested.

(2) Effect of Time

Increased time increased the severity of the test. Testing was not carried beyond 24 hours, because this amount of time showed sufficient indication of the comparative breakdown rates of the enamels.

(3) Effect of Pressure

The effect of increased pressures was not as great as anticipated. The 300 pounds per square inch pressure showed no more action on the ground-coat and acid-resisting enamels than a similar treatment at 90 pounds. It did, however, show a greater attack on the nonacid-resisting cover-coat enamels. In view of the greater success with the 90-pound, 24-hour test, it was not believed advisable to continue the high-pressure tests, which were slow and involved considerable extra trouble.

(4) Effect of Electrolytes

Low concentration of electrolytes showed no effect on the enamels.

In order to accelerate the tests, the underfired plates were used with the high electrolyte concentration. This gave much more readily comparable results than the regularly fired pieces.

The effect of the electrolytes on the various classes of enamel was as follows (the electrolytes being named in the order of their attack from greatest to least):

A1	H_2SO_4, Na_2CO_3, tap water, distilled water.
A4	" " " " " "
B1	Na_2CO_3, tap water, distilled water, H_2SO_4.
C1	H_2SO_4, tap water, Na_2CO_3, distilled water.
C3	Tap water, distilled water, H_2SO_4, Na_2CO_3.

The comparative resistivity of the enamels to the electrolytes was as follows:

Rating	Tap water	Distilled	H_2SO_4	Na_2CO_3
1	A1	A1	A1	A1
2	B1	B1	B1	B1
3	C1	C1	C3	C1
4	C3	C3	C1	C3

(5) Simulated Service Test

From the results of this investigation, it would appear that a simulated service test in which the test samples (underfired by 100°F) are subjected to a pressure of 90 pounds per square inch for 24 hours, while immersed in tap water, and 1500 parts per million solution of Na_2CO_3 or H_2SO_4 should give a good indication of the serviceability of the enamels under test for water-heater or similar service. For most purposes, a test in tap water should suffice, inasmuch as the results of the tests outlined would appear to be corroborated by field service reports at hand.

A study of the effect of many of the various and widely differing waters of the country (a few are listed in Table IV) should prove interesting and valuable.

V. Conclusions

(1) Porcelain enamels withstand the autoclave test remarkably well. They should find more extensive use than at present in services requiring resistance to corrosion by water at moderately high temperatures and pressures.

TABLE IV
COMPOSITION OF SOME CITY WATERS

City	Total solids	Ca	Mg	K-Na	H_2CO_3	SO_4	Cl	NO_3	Total hardness
Baltimore, Md.	74	14	4.1	3.1	47	14	5.1	1.0	54
Bloomington, Ill.	969	203	74	16.7	504	404	8.0	0.0	811
Chicago, Ill.	183	36	10	6.2	144	10	6.0	1.8	125
Cleveland, Ohio	159	35	8.4	5.6	113	25	11.0		120
Dayton, Ohio	434	92	34	9.6	339	84	9.6	13.0	368
Los Angeles, Calif.	378	66	61	33	214	103	28	Tr	251
New York, N. Y.	28	4.5	1.2	1.7	11	7.7	1.0	0.49	20
Portland, Ore.	30	2.7	0.53	3.5	12	3.1	1.3	0.31	8
San Francisco, Calif.	369	38	18	70	276	36	76		166

(2) Ground-coat enamels appear to withstand attack better than other types. Acid-resisting enamels are more resistant than nonacid-resisting.

(3) Hard ground coats withstand the test better than soft; overfired enamels better than underfired.

(4) A simulated service test was developed which appears to show excellent possibilities.

PORCELAIN ENAMEL AND MANUFACTURING COMPANY
BALTIMORE, MARYLAND

COMMUNICATIONS—CERAMIC HISTORY

CHARLES FERGUS BINNS*

The Reverend Doctor Charles Fergus Binns, priest of God, ceramist, teacher, artist-craftsman, philosopher, and author, was born in Worcester, England, in 1857. He spent his early years in the environs of beautiful countryside and the Severn River and his later years in the environs of beautiful countryside and Alfred's Kanakadea. His life reflected those qualities that make beautiful countrysides and quiet flowing streams inspiring. He died December 5, 1934, at the age of seventy-seven years.

Priest of God

It may seem peculiar to those who did not know Doctor Binns to have him listed primarily as a priest of God. Those, however, who really knew the man know that he would have it so. There is no doubt but this was his vocation. Whatever he did, he did in faith of God and under His guidance. His Christian principles guided his daily tasks, and his Christian philosophy was ever present in his discourses. He was born of and brought up by God-loving parents. He was inspired by Christian teachers and was ever ready to spread the doctrines of his Episcopal faith. He was the brother of a clergyman, the father of a clergyman, and married a clergyman's daughter.

The living of a Christian life was to him the most important of all his duties. His, however, could never be considered a passive or selfish sort of Christian life, for he always found time to assist others in finding themselves and in living a fuller life. When a mere youngster in England, he lectured before gatherings on the work and purposes of missions. He was a lay reader in the Episcopal church in Trenton, N. J., and almost immediately upon his arrival in Alfred he set about the task of setting up his church. He was a lay reader in Alfred, N. Y., for twenty-two years and was ordained to the priesthood in 1922 at the age of sixty-six.

It is worthy of note that when, in preparation for his ordination, a list of books was sent him for reading he found practically all on his own bookshelves.

When his church ordained him a priest, it showed its approval of his life and his teachings, it recognized him as one of its leaders, and it made Charles Binns very happy.

With this introduction, perhaps what is said concerning him in his various activities will be better understood.

Ceramist

Charles Binns was reared in a home wherein the word "keramics" was understood. His father, a connoisseur of pottery, a student of archeology, and a director of the "Royal Porcelain Works" of Worcester, and his father's associates who gathered at the Binns' home, planted the ceramic seed in the young boy's brain.

At the age of fifteen he was apprenticed to the Royal Porcelain Works. Luckily he was not apprenticed to a particular trade which would have tied him closely to one part of the factory. He enjoyed the run of the factory which afforded him the opportunity of gaining, at an early age, an insight into the many phases of pottery making. He continued his plant work for thirteen years at the end of which time he was given charge of the Company's London sales office. He remained in London for nine years and then returned to the factory as technical supervisor.

Not much information is available regarding his years as a salesman. One has difficulty in visualizing the man happy in that position, and it must have been a real blessing to him to find himself back in harness at the plant.

His position as a salesman accounts for his coming to America. In 1893 he had charge of his firm's exhibit at the Chicago World's Fair and at that time the idea of coming to America took root. Consequently, when at the age of forty he resigned from the Royal Worcester Works, he was free to leave England. He came alone, leaving his wife and five children in England. After what was evidently a very discouraging year, he obtained a position in Trenton, N. J., and immediately sent for his family. In Trenton, he taught in the Trenton Technical School of Science and Art and did considerable consulting work.

It was during his two-year stay in Trenton that he became active in the organization of the American Ceramic Society. His interest in this Society and his lecture courses led him into putting down in concrete terms many of his accumulated ideas concerning ceramic products and the technique of their manufacture. He promoted the scientific approach to glaze study and contributed much to our early knowledge regarding the relation of body to glaze. His contributions along this line from then on were enough to make him an outstanding ceramist. To him goes a great deal of the credit for our present understanding of glaze formulas and the parts played by various ingredients in the production of glazed ware.

In 1900, President Boothe C. Davis of Alfred University approached him to obtain his recommendation for the filling of the position of Director of the New York State School of Clay Working and Ceramics. He informed President Davis that he would like to accept it himself if he were only free to do so. Circumstances so occurred as to make it possible for him to accept and he did so, thereby becoming the first director of the second School of Ceramics in the United States.

Charles Binns went to Alfred well equipped to take over the directorship of the ceramic school. He was well versed regarding the marketing and technical aspects of ceramic ware and had an exceptional understanding of the quality and artistic merit of pottery. He had had two years in

* Edited by Elsa Binns.

Editor's Note: Twenty years ago Charles F. Binns accepted the secretarial duties of the reorganized American Ceramic Society. He served four years. He is held in reverent memory for his high character and in gratitude for the services he rendered.

which to gather together many of his old ideas and formulate new ones.

From his very early days to his last days in Alfred, he contributed generously to the pages of ceramic literature and his articles deal with many subjects. His discussions on papers presented by others were always constructive and his opinions were always considered ones. While in Alfred he produced two ceramic products, ceramic facts and ceramic men.

He was the author of Ceramic Technology (1896), The Story of the Potter (1897), and The Potters Craft (1909) and (1922).

As concerns his association with the American Ceramic Society of which he was a Charter Member, the following notes are of interest: he was one of its first three officers, he was Vice-President in 1899, he was President in 1900, and he was Secretary from 1918 to 1922.

Teacher

Students whose privilege it was to take lectures from Professor Binns regarded him as a truly great teacher. Before a word was spoken, a respectful hush fell over his class room. The student, having confidence in his teacher's knowledge, listened attentively as that knowledge was being ably imparted to him. One was conscious that teaching was a pleasure to the teacher and that underlying a demanding delivery were qualities of patience for and understanding of the student. On leaving the class room, the student was aware of his own responsibility regarding what he had heard and was inspired to learn more about the subject.

When, as a freshman, you heard him say, "If you are made of the proper metal, we can temper you; if not, we can do little with you," you really wondered whether or not you could be tempered and how long it would take. When, as a sophomore, you had to submit questions to him for answering you knew he was right when he said, "I can tell more concerning what you know by the questions you ask me than by the answers you give to my questions." When, as a junior and senior, you felt free to go to him with your problems, you knew you would obtain a considered opinion. When you heard his final wish for you as you stood proudly in your cap and gown, a large lump would come in your throat and you could say nothing of what you felt.

His teaching went beyond ceramics. He seasoned his ceramic discourses with words and phrases which caused one to consider those things that are far more important than the knowledge of a subject. Perhaps the following excerpts from lectures given by him before faculty gatherings will explain his own concept of a teacher.

"The Religious Life of the College"

"Knowledge of student personality is most important in our work. We must be able, if we are to be successful teachers, to prove student character, to detect signs of failure, and to hail evidences of improvement. We must be ready to call the erring student to task in a loving way, not content merely to give the story to the registrar and record a failure in indelible ink.

"They are with us but four years at the longest and in that short time it is laid upon us to counteract the influence of an unhappy home, to sun life into a stunted character, to curb gently a too headstrong ambition, to satisfy the cravings of a hungry mind, to stimulate a jaded appetite for knowledge—in a word to take such material as comes to hand and shape it into a man."

"The College Man in Industry"

"The college world is far more than a cosmos of facts. Facts there must be as a foundation upon which to build, but any one can own an encyclopedia. Add to the facts the personalities of the instructors and the association with a group of students with similar and sympathetic aims, add the competition of the class within itself and of class with class, add the rivalry and discipline of the football field, add the thousand and one things which are summed up in the word 'environment' and the college stands unrivaled as a means of enabling one to adjust himself to any circumstances or conditions he may meet.

"In sending graduates and short-term students into the industrial field, I have several times been struck by the importance of a college training in the matter of adaptability. While the technical work is built upon a foundation of facts, it is obviously impossible to present to a student a fund of information upon which he can draw checks without limit. It is possible, however, as has been proved repeatedly, to so equip a student that he will be prepared to meet a new situation with success and satisfaction."

Artist-Craftsman

The "potters wheel" of which Charles Binns talked so reverently and the clay which he exalted so highly were two of his best friends. To them he took many of his problems. The hum of the wheel and the feel of the clay were soothing and restful to him.

The pieces he made were conceived before the wheel was approached, even to the textures and colors of their glazes. The ware was made from carefully prepared grogged stoneware body thoroughly wedged and thrown to approximate dimensions. In the leather-hard condition, the pieces were turned to exact dimensions and the walls brought to an even and appropriate thickness. Owing to his desire to have all his pieces of proper weight and balance, he threw his larger pieces in sections, bonding the sections together with slip after turning. The feet of his pieces had as much if not more attention than other portions, for the foot must be depended upon to carry the piece, on the wheel, through the fire, and forever after. A Binns "foot" need not carry his "C. F. B." for one to recognize it, for there are few pieces of pottery whose feet will show the care and forethought that are reflected by them. He was justly proud of the feet of his pieces and talked consistently on the importance of the foot to the piece.

His ware was first hardened by a low fire, to permit handling, glazed and then fired to cones 11 to 12, the body and glaze maturing at the same temperature.

He was a master of glazes and was continually experimenting with them. His experimental work was carried out with a purpose in mind. Having decided upon the character of a glaze that would please him, he would proceed to develop it. There is as much character in a Binns glaze as there is in a Binns shape. Their full appreciation is had only by those who have time to look at them. The glazes as well as the shapes they cover reflect the conser-

vative nature of their master. They might easily be ignored by the ordinary observer but by a connoisseur, never.

Charles Binns considered that the proper glaze on a properly shaped and fired body made a piece of pottery. With those who preferred various types of decoration, he did not argue but deep down in his heart he felt that decoration was unnecessary to a properly executed piece of art pottery.

He countenanced no slip-shod work, and to him that which was not well done was considered not done. His pieces when finally taken from the kiln had to pass his own criticism and should one show a fault it was relegated to the scrap pile. This was not easy for him, for even those with faults had cost him much in thought and labor.

There are few who can conceive a beautiful piece of pottery and at the same time have not only the ability to execute the piece but also the care and industriousness to make it perfect. Such a man was Charles Binns and his ware stands today a distinct contribution to the ceramic art of this country. His pots will carry their dignity and sincerity even unto sherds, for they were made for beauty and service for yesterday and tomorrow.

Philosopher and Author

The writings of Charles Binns were not confined to ceramic subjects. He wrote many articles of a religious and philosophic nature. These articles were often a blend of philosophy and religion, being bonded, as it were, by a ceramic bond. He used ceramic terms to demonstrate his philosophy and he used his philosophy to impart ceramic training.

He handled words brilliantly and was able in prose or verse to express his thoughts. The short plays he wrote for the "Wee Playhouse," which he enjoyed so much, were outstanding examples of his ability in this regard and the following excerpt from his play, "The Hawthorn Vase," a chinese fantasy, will serve to show, more than anything that can be said, the nature of his writing. An analysis of this excerpt will point out the manner he had of utilizing the various tools at his command.

"My son, you have offended. Not to me alone is expiation due but to the gods of righteousness and truth. Our fathers and their ancestors have taught that wisdom must prevail, that truth is everlasting and that we would be wise, must e'en be true. 'Tis no excuse to say that man must live; better to die than live deceitfully. Your fault is evident. You have yourself confessed. Confession is a balm which heals the guilty heart, but yet cannot be held to take the place of restitution. Something must be done to make amends. Requital of the fault in such a way that you will not forget the lesson taught. Go forth and meditate and pray and work that wisdom may be yours, then bring to me your offering. Offer no worthless thing. No money which is earned by simple toil, not that which costs you naught. Bring some new thing, the fruit of brain and skill, strength of the earth or beauty of the sun, glory of morning and the breath of spring, skill of the hand and purity of fire and, if the gods shall crown your labor with success, return and tell me so. Six moons I set for the fulfillment of your task. I treat you here not as a criminal but kindly, for I know you well. Perhaps you did not know, but many years ago I knew and loved your father. He, my friend, laid you within my arms when but a babe. He charged me guard your tender life should he by evil chance be laid away. A few years passed and then he died and I had lost my friend. We thought it best you should not know I was to be your guardian but I followed your career with constant care. I meant that you should grow and learn by independence, as your father did, but judge my chagrin and disappointment when I found that you when tempted fell and must be brought to me for judgment. I who would have gladly suffered in your stead must punish one who seemed to me a son. Imprisonment should be your due but I have shown you mercy. Go and make your task your own redemption, none will greet success with greater joy than I."

The Man

Charles Binns was born and bred a gentleman. He was a shy person and one with a charming manner. His looks and carriage impressed one favorably on first sight. He was a conscientious worker and had the ability to plan his work and the industriousness to work his plans. The power of concentration was one of his greatest assets and his very retentive mind was ever at his command. He read a good deal, mostly on subjects having to do with ceramics, philosophy, or religion and he enjoyed good detective stories.

His greatest pleasure came from "doing something" either alone or in coöperation with others. He enjoyed dramatics and liked to work in his garden. A good smoke was restful to him and though he preferred his pipe, he liked a good cigar.

He welcomed visitors to his home, especially students, in all of whom he took a personal interest. Not being what might be termed a talker, he usually reserved his speech until he had something to say.

He was a "family man" and enjoyed being and working with his family about the home. He suffered two great losses, that of his son in 1912 at the age of twenty-eight and that of his wife and partner after forty-two years of happy companionship.

He was never known to "beef." Should something be wrong, he either adjusted it or saw to it that it was adjusted. He placed his trust in his fellow men and never interfered with the other fellow's job.

He lived a full life and grew old gracefully, there not having been a time that he did not have something at hand with which to occupy himself.

—J. F. McMahon

THE ORTON MEMORIAL LIBRARY OF GEOLOGY

By J. A. Bownocker, '89

Note by Editor: In his last will and testament, probated in 1932, five years after these notes by Dr. John A. Bownocker were written, Edward Orton, Jr., bequeathed $10,000 as a permanent endowment to be deposited in the treasury of the State of Ohio, drawing $600 annual interest to be applied to the upkeep of this library. Dr. Bownocker wrote this story in 1927. His death occurred in 1928.

In 1916, Professor Edward Orton, Jr., generously proposed to the Board of Trustees of the Ohio State University to establish a library of Geology in memory of his father, Dr. Edward Orton, the first President and the first Professor of Geology in the institution. Accordingly, the Board of Trustees designated space on the second story of Orton Hall, and from plans and funds furnished by Professor Orton, this space was transferred into a beautiful reading room and stack room adjacent. This was done after Professor Orton had left the University and while he was serving in the Army. The new library was opened November 1, 1917.

It was thought that the facilities thus provided would be adequate for a long time, but in a few years space had already become scarce. The Professor, now known as General Orton, in 1923 offered to equip larger quarters in Orton Hall if the Trustees could grant the use of the space. They finally granted the commodious room, 40 by 70 feet, two stories high, with balcony, in which for years the main part of the University Library was housed. This handsome room, thoroughly reconstructed and furnished, was opened January 2, 1925.

The woodwork is quarter-sawed oak finished in a soft light brown. The walls above the cases are panelled. The columns which support the balcony are of oak, surmounted with hand-carved capitals of Romanesque design. The main study tables occupy the central part of the room, and special study desks for advanced students in geology are placed at secluded ends of the room. A specially designed case provides for the topographic maps and folios of the United States Geological Survey and is adequate to take care of these for many years. The radiators are enclosed by wooden grilles of attractive design. The floor is laid in light brown cork tile, harmonizing with the woodwork in tone. The room and the furnishings and equipment as a whole are a really distinguished piece of work in its simplicity, beauty of form and material, and artistic finish.

The lighting of the library has been given careful consideration. The general illumination is provided by a central chandelier and four corner brackets, using glass lanterns of unique and artistic design. Study tables and desks are equipped with individual lamps. The lights under the balcony are hidden from the center of the room and are of orange shade to bring out the tone of the woodwork.

The space between the tops of the wall cases and the ceiling of the balcony is to contain a suite of oil paintings of geological subjects. Some of these paintings are already in place, one being a portrait of Dr. Orton by the late Silas Martin. The most ambitious of the paintings is one illustrating denudation, Thomas Moran's "Petrified Forest," a 30- by 60-foot canvas in the artist's best style. "Mt. Sir Donald," a quartzite peak in the Selkirk Range by Bierstadt; a study in crumpled and folded rocks on Cape Elizabeth on the Maine Coast by Alexander Bower; and an abandoned glacial cirque, with fine glacial gorges, in the Rocky Mountain National Park by Dean Babcock are the most noteworthy of the remaining pictures. It is expected to add paintings of other subjects, glacial, volcanic, etc., as opportunity offers.

On entering the library, the white marble bust of Dr. Orton at once catches the eye. It is placed at the farther end of the wide central aisle and the specially designed background virtually constitutes a frame for it. Older graduates will recall that this bust was presented by the Alumni Association. The artist was Mrs. Annetta Johnson St. Gaudens, widow of the sculptor.

The books, in 1917, number about 11,000 and include many of the largest and most important sets published here and abroad. They include the University collection, the State Geological Survey exchanges, the library of the late Professor Charles S. Prosser, and numerous volumes from the library of Dr. Orton. For the past five years, General Orton has supplied $500 annually for the purchase of books. Volumes donated or purchased with donated funds are bound by the State without expense to the library. Under such favorable conditions, the collection is, of course, growing rapidly. Stack room for about 25,000 is already provided, and by connection with a room below at least 50,000 volumes can be housed. It is a library not only for the needs of the Ohio State University but for geologists from any state or country. As time passes, it bids fair to become one of the most outstanding collections on the subject anywhere.

This library has been a long-cherished idea with General Orton. It is a product of his vision and generosity and of his alone. It is by all means the most imposing gift to date of an alumnus of this University, and it is destined to become of national importance with the passage of the decades.

NOTES ON EARLY AMERICAN PORCELAIN*

CONTRIBUTED BY WILBER STOUT

American Porcelain

We have great pleasure in congratulating our fellow citizens on the complete success which has attended the effort to establish a manufactory of porcelain in the city of Philadelphia.

From the manufactory of Messrs. Tucker and Hulme, we have received specimens in the state of biscuit, baked—of the ware, baked and glazed—and of the ware, gilded and painted, the sight of which must afford pleasure to every friend of American arts, and especially of an art so difficult, and which is scarcely a century old even in Europe, although practiced for many centuries in China and Japan.

The porcelain of Philadelphia is very beautiful in all the principal particulars, in symmetry of modelling, in purity of whiteness, in the characteristic translucence, in smoothness and lustre, and in the delicacy and richness of the gilding and enamel painting. That it *rivals* the finest productions of Sèvres, itself, it is not necessary to assert;

* From *The American Journal of Science and Arts*, Vol. XIV (July 1828) and Vol. XVIII (July 1930). Conducted by Benjamin Silliman, M.D., LL.D.

but it certainly gives great assurance, that if properly supported, it will not fail to meet every demand of utility and taste which this great and growing country may present.

We pretend not to judge of the political and commercial circumstances which may influence the success of this manufactory; the art now stands forth in this country in all the attractions of utility and beauty, and we sincerely hope that it may prove as lucrative to the proprietors of the establishment as their productions are honorable to their skill and enterprise. It appears from Mr. Carpenter's memoir in the early part of this number that the raw material is very abundant at no great distance from Philadelphia, and it is well known that it is found in many parts of the United States.[1]

On page 7, George W. Carpenter of Philadelphia gives an account of the mineralogy of Chester County and also of the minerals of Delaware, Maryland, and other localities. An extensive bed of kaolin occurs on Israel Hoope's farm in New Garden Township. This substance is extensively employed in the manufacture of porcelain ware. Two manufactories, the only ones yet established in this country, are supplied from this locality.[2]

Feldspar

An extensive bed of feldspar occurs adjoining Dixon's farm in New Castle County, Delaware. The land containing it has lately been purchased by W. E. Tucker of Philadelphia, who employs the article extensively in the manufacture of porcelain ware. This ware, of which feldspar is an important constituent, has been brought to such perfection by Mr. Tucker that it is pronounced by competent judges to possess a soundness of body, smoothness of glazing, and beauty of lustre fully equal to the imported ware and surpasses, in purity of whiteness, either the French or English china which is not within our market.[3]

The Editor of the *American Journal of Science and Arts* makes the following comment[4]: "The manufactory of porcelain at Jersey City, one of the two mentioned in the preceding account, has, we understand, been discontinued, and that at Philadelphia is stated to be the only one in the United States."

[1] *Loc. cit.*, Vol. XIV, p. 198.
[2] *Loc. cit.*, Vol. XIV, p. 7.
[3] *Loc. cit.*, Vol. XIV, p. 11.
[4] *Loc. cit.*, Vol. XIV, p. 14.

Porcelain of Philadelphia[5]

This fine product of our domestic arts was mentioned in Vol. XIV, p. 198, of this *Journal*. There is little to add to what was then (we have great pleasure in saying truly) stated relative to the beauty and excellence of the porcelain of Philadelphia; but a recent visit to the manufactory places it in our power to say that it is going on with vigor and success. It is now under the entire management of Mr. Tucker, and there is exhibited in his premises sufficient evidence of skill, good judgment, perseverance, and efficiency to justify the belief that the establishment will be permanent and will admit of due extension as the demand shall increase.

Mr. Tucker is very fortunate in the possession of the best materials, which are obtained in the greatest abundance in the southern parts of Pennsylvania and in Delaware. Besides the proper porcelain clay, he uses also feldspar and quartz. The feldspar is from a huge vein in Delaware. The most common pieces that are used in the manufactory are beautiful, and many of them sufficiently so to form ornaments of cabinets and are little inferior to the adularia of the Alps. White quartz is also used; both are calcined to aid the pulverization which is affected by proper mills. The powders are then mingled in water and form an excellent basis.

If we possessed all the facts, and it were proper to publish them, we are not now disposed to enter into the details of the manufacture; and it is mentioned again, that we may say, from personal inspection and a very full and obliging exhibition of the manufacture by the proprietor, that we entertain the fullest conviction of its entire success. The porcelain is excellent and very beautiful, and as the public affords Mr. Tucker encouragement by purchasing liberally his fine productions, he will be able to add all the embellishments in the merely ornamental part of the manufacture which fancy and taste may require.

In surveying, with some attention, the great improvements which the lapse of a few years has introduced into Philadelphia and its environs, nothing impresses us more agreeably, even in this city of institutions, science, and arts, than this unostentatious, but perfectly successful manufacture of porcelain. The patriotism of this country will make no sacrifice by affording Mr. Tucker all the encouragement which he can desire and which he so richly deserves.

[5] *Loc. cit.*, Vol. XVIII, pp. 384–85.

MAYA AND PERUVIAN CERAMICS

By Maurice Ries

Pottery-making was as constant and as common a material art in the Americas before Columbus as any art can be. It was a minor art, to be sure, in the category of material arts, a category that places architecture and sculpture in the most important position, and as minor arts considers ceramics, basketry, textiles, lapidary, metalworking, lesser and nonarchitectural carvings, personal adornment—tattooing, principally—and, perhaps, the production of those manuscripts that are deserving of artistic consideration because they have been ornamented or illuminated.

But if the ceramic art was a minor one in the pre-Columbian western hemisphere, when one takes into account all of north, south, and middle America, it was the foremost of this group. At its highest, among the leading cultures, it was a major art.

Pottery-making occupied the attention of early Americans over a vast area, from southern Canada to the central part of the Argentine. As might be expected, it reached its peak toward the center of this immense region. To be precise, it reached not one peak but four: on the Pacific

side of Peru, in Central America and south Mexico, in central Mexico, and in the United States southwest. But the four peaks were not of equal heights. The Peruvian eminence towered above the others, with that of the Maya second, the Mexicans third, and with United States southwest ceramics last, but still a peak.

Peruvian pottery, textiles, and engineering, Maya sciences, architecture, sculpture, Mexican metalworking and administrative ability, and Inca agriculture: these were the wonders of ancient America. If Maya pottery is not included in this brief list, it is only because its excellence was overshadowed by the amazing achievements of the Maya architects and sculptors and scientists. Their work does not relegate Maya ceramics to a lesser position; these other activities simply are more astonishing.

Maya pottery was second only to the almost unbelievably beautiful ceramics of Peru. And by "Peru" one must not understand "Inca." In fact, wholly Inca ceramics are inferior to those of other parts of what is known to the mapmakers today as Peru. It was the pre-Inca peoples, the Nasca and the Chimu potters, who gave to the world some of its finest ceramics of antiquity.

Oddly, one of the smallest of American museums has within its walls today collections of Maya and Peruvian pottery that are considered among the very best in the world. This is the Museum of the Department of Middle American Research at Tulane University in New Orleans.

Since it was founded, in 1924, the Department of Middle American Research has specialized in the culture of the ancient Maya who inhabited northern Central America and southern Mexico, without ever having funds allotted for the purchase of museum specimens and, in fact, without ever trying to build up an exhibit collection of Maya archeological and ethnological material. It does not claim to have as many or as excellent examples of Maya art as the Peabody Museum of Harvard University or as fine individual pieces as some in the University Museum at the University of Pennsylvania. But its Maya jades are the best; it has the largest known collection of Guatemala Indian (present-day Maya) costumes; its Maya marginal pottery from the Ulua valley is unsurpassed; its Maya marble vases from the same valley are unequalled.

And with the collection of Nasca and Chimu ceramics now under its roof, Tulane's Department of Middle American Research clearly can say it possesses the foremost collection of the best pottery of the ancient Americas.

Better known than Maya pottery is that of pre-Inca Peru. As a whole, it is thinner, more refined, more permanently decorated and slipped, and better preserved. But it does not excel Maya pottery in variety of shape or design or in practicability, and it does not always excel in sheer beauty of line and color.

Peruvian potters of a long-dead yesterday were without peers in their craft. Perhaps there were better Greek artists who decorated ancient Grecian ware, but for harmony of completed effect, the Nasca and Chimu craftsmen had nothing of which to be ashamed. Time was friendly to them; dry sands bearing benevolent chemicals preserved their work as the damp jungles of Middle America, with their extremes of heat and rain, could never keep Maya ceramics unharmed. Two-thousand-year-old pre-Inca pottery from the Pacific coast of Peru makes even the expert hesitate in declaring genuinely ancient its magnificent coloring and fragile perfection. But ancient Maya pottery is unqestionably ancient. It has suffered; and when, in spite of 10 or 15 centuries of dampness and burning sun, of running water, calcium deposits in its pores, the ravages of roots, and sundry other perils, it emerges still beautiful, that is the sincerest of tributes to the Maya ceramists of the past.

As their descendants are today, the Maya of antiquity were busy potters and busy traders. Then, as now, there was much native commercial intercourse within and outside the Maya area, and this has complicated the study of Maya pottery considerably. The products of a good pottery were spread far and wide. The result is a problem in diffusion and identification fascinating to archeologists.

The ceramic industry can take a large and justifiable pride in the fact that fired clay is one of the least perishable of all materials. With the possible exception of a few (and consequently rare) stones, through the centuries no archeological object outlasts baked clay.

Architecture, or stone sculpture, may be a higher art, which is debatable, but ceramics is the more permanent one. Of the half-dozen natural groups into which the more artistically distinguished pottery falls, only one (painted pottery) is less enduring. And even in this classification, the pottery does not perish: only its painted decoration is lost or damaged.

Maya pottery fits harmoniously into the following groups: (1) plain vessels, (2) vessels with decoration modeled in relief, (3) vessels with molded or stamped decoration, (4) vessels with incised decoration, (5) vessels whose decoration is painted on, (6) effigy vessels, made in the shapes of animals, fish, fruit, etc., and (7) miscellaneous ceramics, *i.e.*, whistles, figurines, molds, stamps, spindle-whorls, incense-ladles, etc.

(Perhaps it will be contended that plain vessels cannot be considered as artistic. That would be a ridiculous contention. To be convinced one has only to view a long list of ancient and modern ceramists whose work is complete without extraneous adornment.)

All Maya and Peruvian pottery, in fact, all the pottery of the ancient Americas, belongs to what is regarded as the first stage of ceramic development, porous pottery. The other two stages, in order of advancement, are glazed porous ware and vitreous pottery.

The potter's wheel being unknown in the New World, all early American pottery is the result of two activities, coiling or molding. It was never thrown. Mold-made ceramics were not precisely rare; among the Maya, molds for making complete pots have been found by archeologists. But most of our Group 6 were mold-made objects. Mass production was no invention of modern machine-age America.

Incidentally, whereas there was never a potter's wheel in use in pre-Columbian America, sometimes the ancient potter sat on the ground with a block of stone between her feet and, with heel and toe she turned the stone, slowly, as she shaped her clay. This is a method still in use in a few places in the Maya area. But the essential value of the potter's wheel is the assistance lent by the centrifugal force it produces; the stone block never was and never could be turned with any rapidity.

Considering the fact that in the Americas open firing was the only method practiced, the quality of the best New World pottery was surprisingly fine. And this in the face of the fact that good results from open firing are largely a matter of accident.

These were weaknesses in the ceramics of the New World. But there are indications that higher developments were on their way: improvements that were halted and destroyed by the Spanish Conquest, during the 16th Century.

Archeological evidence points to the probability that American ceramics began in Middle America and spread northward and southward, eventually to the tremendously distant limits of the Argentine and Canada. If this is true, then it is likely that pre-Maya people were the first ceramists of the New World. This development into pottery making probably came late. . . . .perhaps as late as the first thousand years B.C. Like all primitive pottery, shapes were determined by need, *i.e.*, the call for pots in which to cook, for vessels in which to carry food and water. Again following the usual development of primitive crafts, decoration began to be added as the development of agriculture yielded leisure, for leisure produces art. Functional design was the basic creation; pure design and the technique of decoration evolved, and showmanship, the desire to show technical skill, eventually resulted in the application of design foreign to ceramics and in the actual production of ceramics for purposes not at all appropriate to pottery and pottery materials.

Maya pottery, despite the fact that it became highly decorative in the years shortly before Hernando Cortés launched the Spanish Conquest in that area in 1519, by and large remained functional. Thus, in shape, it was unspoiled and in design, admirable. It conformed to the two leading techniques of (*a*) manipulation of surface and (*b*) addition to surface; that is, its manipulated surface was incised, carved, pierced, impressed, and polished, and to the surface were added hand-modeled forms, molded forms, slips, and paint.

A brief comparison is given in Table I between the two regions where pre-Europeanized pottery in the New World reached its highest development, that is, among the Maya of Central America and among the Nasca and Chimu of Peru.

Of course, Table I does not pretend to make any sort of complete comparison. It suggests only the essential features of such a comparison. It fails to point out, for example, such interesting details as these: that in some parts of the Maya area, as in parts of Guatemala and in the Ulua valley, a clay was used which contained a large amount of mica, with the result that the unpainted products of these territories sparkle merrily today. It does not cite the fact that some vessels from the Petén region of Guatemala and southern Mexico were made of a gray, very coarse clay containing small pebbles and that these vessels, fired at a high temperature, are quite soft.

The shapes in which Maya pottery was made were tremendously varied. The tripod bowl is considered the

TABLE I

CERAMIC COMPARISON BETWEEN MAYA AND PERUVIAN CULTURE AREAS BEFORE 500 B.C. TO 1500 A.D.

	Maya	Peru
Place	Guatemala lowlands, Yucatecan hill-country	Pacific coastal lowlands, foothills of Andes
Potters' ability	Second only to those of Peru in the western world	Best of all pre-Columbian American ceramics
Highest period of development	During first culture ascendancy, before B.C. 500–A.D. 500; during second culture ascendancy A.D. 1000–1520	During first culture ascendancy, before A.D. 1–500
Kind of ware	Porous	Porous
Methods of manufacture	Coiling, molding; no potter's wheel; majority of bottles, plates, bowls, jars mold-made	Coiling; no potter's wheel; mold-made pottery common
Characteristic shapes	Cylindrical vessels and jars on grotesquely modeled tripods; also effigy whistles; human figurines	Effigy water-bottles: portraits, fruit forms, and double-forms, usually connected with a tubular bridge
Color of unpainted ware	Fine, even paste produced hard-bodied ware ranging from cream or light yellow to dark terra cotta, but predominantly red; black rare	Fine, even paste produced thin, even, hard-bodied ware generally orange in color, but ranging from brown to cream
Decoration	Decoration modeled in relief; molded or stamped decorations; incised; painted decoration, polychromatic; mostly religious mythology; incising important	Painted in many colors showing a full range of cultural activities: very unusual for aboriginal peoples; also modeled decoration
Color decoration	Polychromatic; colors used skilfully; paint or slip form; usually oranges, yellows for backgrounds, designs of red, brown, white, nearly always outlined in black	Polychromatic; colors used skilfully; paint or slip form; highly polished red and black vessels most beautiful of plain ware; many colors on one vessel: tan, cream, black, red, gray, purple, pink, orange. Backgrounds: white, red, brown
Painted design	Usually complicated hieroglyphic and religious-mythologic designs; also animals, humans, monsters; inferior to Peruvian ware as pure design, but better in execution of details	Usually effigy and geometric designs and scenes of cultural activities; also animals, humans, monsters, fish, flowers, birds; as pure design, better on Peruvian vessels
Polishing	Used on some vessels	Used on nearly all vessels

most characteristic, its legs usually being grotesque animal heads.

Painted vessels from the first period of Maya magnificence, that which reached its peak about A.D. 500 and declined until nearly A.D. 1000, are rare but usually are good art.

There is nothing constant about the use of a slip covering in the Maya area, although it was employed throughout the region. But the painted decoration was also in slip and in the same colors as the slips. Black generally was employed to outline these colors. Brilliant colors were used but seldom.

Covers were an adjunct to many a Maya vessel, although they are found but rarely today.

Hand-modeled relief ornament was produced throughout the Maya territory. Appliqué ornamentation was common. In short, the Maya potters were a sophisticated, able group. Sometimes their work approached the sculptural, as when they made large solid clay heads, probably those of gods, which are distinctly characteristic of Maya art and Maya artists.

Archeologists one thousand years hence will find our kitchenware and our everyday table pottery to be coarser and heavier than our "art pieces." This is exactly what today's archeologists find to have been true for the Maya.

Finest of all Maya pottery is the polychrome ware. Here the glossy surface produced by polishing is common. Glazing was unknown to pre-European American ceramists, though an accidental glaze was produced occasionally.

And finest of the Peruvian ware is the polychrome.

It is extremely doubtful if there was any connection or intercourse between Maya and Peruvian potters. Yet there are sound indications that this intercourse came near being established. In the region between them, the land of the Costa Rican and Nicaraguan and Columbian and Panamanian potters, there are distinct evidences of cultural overflows both from north and south. Maya and Peruvian pottery never influenced each other, but their development, their technique, and the results were remarkably alike without resembling each other in the least. Both were splendid achievements.

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JOBLESS FIND OUTLET IN CERAMICS

Ceramics affords an outlet for expression of the creative urge deep within every human being. It is an honored craft which will never lose its popularity. It gives the skilled craftsman the means of earning a livelihood in a field that is not over-crowded.

The Federal government, being conscious of these facts, has given impetus toward the revival and maintenance of this art. Designed primarily to give employment to groups and individuals displaying a talent in this field, the Works Progress Administration established ceramic projects in a number of states early in the Federal Works Program.

Now, after months of training and work, the craftsmen on the various projects have attained their finest expression through a wide range of subjects, from large fountains, bowls, and jars to delicately sculptured figures and exquisitely colored tile and plaques.

Three artists on an Ohio project have created exceptionally fine examples of ceramic art. One of the workers, a woman, executed a complete set of glazed figures representing the characters of Uncle Remus and Alice in Wonderland. Two others, both men, have shown an unusual gift in creating figures in high glaze suitable for modern interiors. Their works are original and distinctive.

The workers on this Ohio project received training under experts in the ceramic field, and their work has been such as to win the praise of nationally known artists and craftsmen.

The only Negro ceramics project in the country operates in the District of Columbia. Classes are conducted at Howard University, a Negro college, where more than 150 interested adults and children are taught to make various articles. The work is supervised by a capable man whose own creations are distinctive for beauty and originality of design.

Unusual and highly individualistic are the adjectives which describe the achievement of craftsmen on a New Jersey project. Their work comprises, among other things, a set of six ceramic sculptures designed for Roosevelt Park at New Brunswick. This set of figures is decorative, and the artists have used the medium of clay in an imaginative manner to express a theme that is deeply significant. Two of the figures, "Death" and "Plague," are even more startling because they are done in a medium usually associated with decoration. Their work denotes the highest degree of good taste and esthetic sensibility.

In a CCC camp near Fort Collins, Colo., a group of the men are carving lovely objects from alabaster. Alabaster was a rare and valued possession even in biblical days. It is comparatively rare in the United States today and has never been commercially exploited. Deposits of this soft, stonelike material in northern Colorado are found in many colors, with shadings and streaks which enhance its beauty. Alabaster is easily fabricated, takes a marble polish, and lends itself well to carving. Many artistic pieces such as lamp bases, cases for clocks, candlesticks, figures, vases, and jewel boxes are made by the men in this group which is conducted by teachers of the WPA Adult Education program.

In western North Dakota, where deposits of an excellent pottery clay are found, a state-wide ceramics project operates under sponsorship of the University of North Dakota. Groups of workers are taught every phase of pottery making, from the preparation of the clay and the use of the potter's wheel to glazing and firing. They are learning by actual experience.

Useful as well as attractive articles, which find their way into many public institutions, are made on WPA projects. None is sold to avoid competition with private industry. Colorful and sturdy little mugs, bowls, and plates, which

seem to make a child's food more palatable, are sent to nursery schools and kindergartens. The range of ceramic products produced on these WPA projects covers ceramic figures illustrating a child's favorite stories, plaques depicting the history of transportation, and vases, jars, and many other pieces supplement the equipment of school rooms, children's hospitals, and other tax-supported institutions which often need a touch of brightness and color.

Missouri has ceramics projects which are turning out distinctive work. The blue glaze produced in that State is especially attractive. Nursery sets, plates, pitchers, and dozens of articles are evidence of superior training and a high degree of skill on the part of the WPA workers.

Inspired, perhaps, by the many fine Chinese prototypes, ceramic workers in California have turned to the creation of plates, bowls, and tile, which are truly beautiful and show a real refinement of form and a subtle variation of glaze and crackle.

One of the artists, Cecil Jones, has examples of his work on display in the New York Metropolitan Museum and in museums at Denver and Los Angeles.

One of Mr. Jones' best plaques was on display at the WPA Exhibition of Skills of the Unemployed in the National Museum, Washington, D. C., in January. "Judith with the Head of Holophernes," the subject of this piece, is a reproduction of Italian majolica from a plate made at Coffaggiolo in the 15th Century. It depicts two figures, in flowing white robes touched with dull terra cotta, mounted on white horses in full flight. The bearded, long-haired head of the victim is held high by Judith while an expression of triumph mingled with hate is plain upon her face. Soft clear blue forms the background for the white figures, which stand out dramatically, and finely executed details of face and form make the whole a vivid flash-back to that ancient story.

A group of artists on a Chicago project has done a series of animal figures, original in design, in the medium of white clay. Transparent glaze on white clay accented by an underglaze makes the whole series very interesting. This work is part of a ceramic-sculpture program which will supply a series of decorations for the Brookfield Zoo at Chicago.

An outstanding group of ceramic sculpture done by a New York project worker was recently displayed in the interior decorating shop of Elsie deWolfe in New York City. The figures, done in gay colors, are imbued with a spirit of fantasy, quite in the modern mode.

In New York City, at the old Pioneer Lighthouse, established by the New York Association for the Blind nearly 30 years ago, a project is in operation that is as unique as it is interesting. Under sympathetic guidance, 50 blind women from 20 to 60 years of age are learning the art of pottery making. They make simple flower dishes, little vases, and jars. Even fantastic gargoyles take form from a mere lump of clay under their groping fingers. Since this project began, the women have made amazing progress, so much so that the WPA recently held an exhibition of their work. Articles which they have made are placed on sale at the Association's craft shop. Plans are being made to establish a fund in order to broaden this type of service to the blind.

These blind persons have found through this medium an outlet for the expression hitherto denied them. They find in it release from mental tension and the deadly monotony of darkness. They have, according to their statements, experienced extreme delight in being able "to see" the actual results of their handiwork.

Ceramic Ware Made under WPA Supervision

ACTIVITIES OF THE SOCIETY

D. E. SHARP, GLASS DIVISION TRUSTEE

Donald E. Sharp was born in Corning, N. Y., and received his early education in the public schools of that city, later attending the University of Wisconsin and Carnegie Institute of Technology.

His first contact with the glass industry was in 1914 as assistant to J. T. Littleton in the physical laboratories of the Corning Glass Works. Later, he was assistant, Physics Department, University of Wisconsin, 1916; assistant, Ceramics Department, U. S. Bureau of Standards, 1918; technical director and assistant to G. W. Morey at the optical glass plant of the Spencer Lens Company, Hamburg, N. Y., 1918–1920, and manager, 1921–1925.

Donald Sharp, Glass Division Trustee

In 1925, Mr. Sharp rented and later purchased the optical glass plant and used it as the headquarters for his practice as a consulting glass technologist. He was joined by James Bailey in 1929, when the Bailey & Sharp Company was organized, and became president and general manager of the new firm. In the summer of 1937, the activities of the Bailey & Sharp Company were discontinued when the entire staff was absorbed by the Hartford-Empire Company.

During the years Mr. Sharp spent in Hamburg, he was a director of the Hamburg Savings and Loan Assn., the Eno-Sharp Corp., the Erie Basket Corp., the Hamburg Finance Corp., the Vitaglass Corp., the Vitaglass Manufacturing Co., and for twelve years was a member of the Board of Education of the Hamburg schools. Until recently, he was confidential representative in the U. S. A. for Chance Bros. & Co., Birmingham, England. During 1930–1931, he was associate technical editor of *The Glass Industry*.

Among other patents and developments, Mr. Sharp has invented two reflection devices for use as automobile tail lights. He is president and treasurer of the Reflex Highway Sign & Signal Co., and a director of Optical Glass Products, Inc., Hamburg, N. Y.

Mr. Sharp has been a member of the American Ceramic Society since 1917 and a Fellow since 1936. He was councillor of the Glass Division in 1923 and vice-chairman in 1931. He is also a Fellow of the American Association for Advancement of Science and of the Royal Society of Arts (British). He is a member of the American Chemical Society, American Optical Society, American Physical Society, and the Society of Glass Technology (British).

Publications

(1) "A Simple Expansibility Test for Determining Welding Properties of Glasses," *Jour. Amer. Ceram. Soc.*, **4,** 219 (1921).

(2) "Design of a Furnace for Annealing Optical Glass," *ibid.*, **4,** 597–607 (1921).

(3) With W. H. Rising, "Manufacture of Reflecting Telescope Discs," *Ind. Eng. Chem.*, **14,** 511 (1922).

(4) "Notes on Manufacture of Telescope Discs in America," *Jour. Roy. Astron. Soc. of Can.*, pp. 175–78 (1922).

(5) "Recent Developments in Optical Glass Making in America," *Popular Astronomy*, 30 (1922).

(6) "Silvering of Glass," *Glass Ind.*, **11,** 273–76 (1930); *Rev. belge ind. verrières*, **1,** 243–44 (1931); *Diamant*, **53,** 319–21 (1931).

(7) With W. Bloch, "Arsenic as an Ingredient in Glass," *Glass Ind.*, **11,** 153–56 (1930).

(8) With E. J. Moore and H. S. Lein, "Optical Properties of Didymium Glass," *ibid.*, **12,** 49–51 (1931).

(9) With J. Bailey, "Some Physical Tests of Value to the Glassmaker," *ibid.*, **12,** 179–83 (1931).

(10) With J. Bailey and I. Hyman, "Apparatus for Determining Annealing Constants of Glass," *Jour. Amer. Ceram. Soc.*, **14,** 820–26 (1931).

(11) With A. K. Lyle, "Color Changes in Flint Glass," *ibid.*, **16,** 380–84 (1933).

(12) With J. Bailey, "Release of Strain in Glass," *ibid.*, **16,** 367–79 (1933).

(13) "Chemical Composition of Commercial Glasses," *Ind. Eng. Chem.*, **25,** 755–64 (1933).

(14) "Weathering of Lime Glass," *Nat. Glass Budget*, (Nov. 3, 1933).

(15) "Note on Feldspar in Sheet Glass," *Nat. Glass Budget*, (Sept. 16, 1933).

(16) With E. R. Riegel "Properties of Some New Glasses Containing Bismuth," *Jour. Amer. Ceram. Soc.*, **17**, 88–92 (1934).

(17) With Waring Bradley, "A Bibliography of Alumina and Feldspar in Transparent Glass," *Glass Ind.*, **15** (Nov. and Dec. 1934).

(18) With W. Horak, "Note on Influence of Zirconia on Elasticity of Some Soda-Lime Glasses," *Jour. Amer. Ceram. Soc.*, **18**, 282–84 (1935).

(19) With W. Horak, "Note on Effect of Zirconia on Chemical Durability of Some Borosilicate Glasses," *ibid.*, **18**, 281–82 (1935).

(20) With A. K. Lyle, "Feldspar as a Chemical Raw Material," *Chem. Industries*, **38**, 248–50 (1936).

(21) With A. K. Lyle and W. Horak, "Effect of Alumina upon Chemical Durability of Sand-Soda-Lime Glasses," *Jour. Amer. Ceram. Soc.*, **19**, 142–47 (1936).

(22) With W. Horak, "Effect of Alumina on Devitrification of Some Soda-Lime Glasses," *Glass Ind.*, **17**, 162–64 (1936).

(23) "Chemical Composition of Commerical Glasses," a chapter in book by S. R. Scholes, Modern Glass Practice, (1935).

(24) Feldspar as a Constituent of Glass. Booklet published by Nat. Feldspar Assn. (1937); edited by D. E. Sharp.

REPORT ON THE ANNUAL MEETING OF A.I.M.M.E.

The Annual Meeting of the A.I.M.M.E. was held in New York City, February 13–17, 1938. Three sessions of the Educational Division were devoted to the topics of pre-college guidance and the four-year *vs.* five-year curriculum for mineral technology students.

In connection with pre-college guidance, the question of placing before high-school students the opportunities in the various branches of the mineral industries field was fully discussed. The A.I.M.M.E. is preparing a booklet on the subject which will include a chapter on ceramic engineering prepared by C. W. Parmelee. Thirty thousand copies of this booklet are to be distributed free to the high schools of the country.

The inclusion of ceramic engineering in this booklet is a direct result of the attendance of the Chairman of the Committee on Ceramic Education at the annual meeting of the A.I.M.M.E. in 1937, at which time his request that it be included was granted. This action confirms his previous recommendations that the ceramic engineers be officially represented at the meetings of this organization in order to coördinate educational work in the mineral industries field. The Institute of Ceramic Engineers will be the only independent organization representing a branch of the mineral field. All other branches are represented in the A.I.M.M.E.

In order to give the mining, metallurgical, and other engineering educators a clear-cut idea of the field of ceramic engineering, your representative presented, at their request, a paper entitled "Ceramic Engineering and the Nonmetallic Field." In this paper was explained the origin of ceramic engineering and the claim was made that it now includes the entire nonmetallic field, with the exception of the fuels, and ores as such. A plea was made that the mining engineers, who use the term "industrial minerals" for all nonmetallics, adopt the term "ceramic minerals" in its stead.

That acceptance of our claim to the nonmetallics is gaining headway is indicated by the following quotation taken from the Institute program: "A. F. Greaves-Walker will present a paper on ceramic engineering education, which is coming to be accepted more and more as that branch of mineral technology which embraces the industrial minerals."

There appears to be no strong opposition to the suggested change on the part of the mining educators, but until recently their knowledge of the ceramics field has been so limited that no hasty action can be expected. It is the opinion of your representative that it will be accepted in time, if the effort is continued.

The ceramic engineers can now rest assured that they have been accepted as "blood brothers" in the mineral industries group. Much of the credit for this acceptance is due to W. B. Plank, head of the Department of Mining and Metallurgical Engineering, Lafayette College, who was, during the past year, chairman of the Educational Division, A.I.M.M.E., and also of the old Committee on Mining and Metallurgical Engineering, S.P.E.E. His interest, advice, and assistance in our efforts to gain recognition as a separate and independent branch of the mineral industries has been invaluable.

—A. F. Greaves-Walker, *Chairman*,
Committee on Ceramic Education

LOCAL SECTION NEWS

MICHIGAN-NORTHWESTERN OHIO SECTION

The Michigan-Northwestern Ohio Section held a dinner meeting on February 18 at the Durant Hotel in Flint, Mich.

Following the dinner, R. B. Sosman, U. S. Steel Corp., Kearny, N. J., presented an illustrated lecture on "Iron-Bearing Silicates in the Iron and Steel Industry."

After the lecture, W. N. Hardie acted as Master-of-Ceramicmoanies" for an interesting entertainment given by the members of the Section.

PACIFIC-NORTHWEST CLAYWORKERS' ASSOCIATION AND SECTION OF AMERICAN CERAMIC SOCIETY

The annual meeting of this group was held at the University of Washington, Seattle, Wash., March 5, 1938.

The following program was presented:

(1) "Pottery Making in Seattle," by LEROY BACKUS, Potlatch Pottery.
(2) "Factors in Die Construction and Operation," by HOWARD MANSUR, Gladding, McBean & Co., Lincoln, Calif.
(3) "Clays of Southwestern Washington," by MARION SAINDON, Chehalis Brick & Tile Co.
(4) "Fire Clays of Western Oregon," by RAY C. TREASHER, Geologist, Oregon Department of Geology and Mineral Industries.
(5) "Waterproofing Brickwork," by E. O. EASTAUGH, A. C. Horn Co., Seattle.
(6) "Grouted Wall Construction," discussion led by F. G. BURROWS.
(7) "A Side Line for the Clay Man," by C. R. PATE, Univ. of Washington.
(8) "Federal Housing Administration," by CLARK JACKSON, Administrator for Seattle District.

Following a banquet at the Meany Hotel, the President's address was made by NEAL FOSSEEN, Washington Brick, Lime, and Sewer Pipe Co., Spokane, Wash., and S. J. COON, Dean, College of Economics and Business Administration, University of Washington, talked on "Economic Changes."

The newly elected officers for 1938–1939 are as follows:

President: F. G. BURROWS, Chehalis Brick & Tile Co., Chehalis, Wash.
Vice-President: O. K. EDWARDS, Willamina Clay Products Co., Portland, Ore.
Treasurer: H. O. THOMPSON, Builders' Brick Co., Seattle, Wash.
Secretary: HEWITT WILSON, Univ. of Washington, Seattle, Wash.

—HEWITT WILSON, *Secretary*

PITTSBURGH SECTION

Members of the Pittsburgh Section met at Mellon Institute, March 8, 1938. The speaker for this meeting was Robert B. Sosman, U. S. Steel Corp., and President of the American Ceramic Society. Dr. Sosman's subject was "Iron-Bearing Silicates in the Iron and Steel Industry."

Dr. Sosman showed many interesting and valuable applications to slags and refractories of the equilibrium diagrams in the systems involving the oxides frequently met in steel furnaces, such as SiO_2, Al_2O_3, Fe_2O_3, FeO, CaO, and MgO.

Ninety persons attended this meeting.

—C. L. THOMPSON, *Secretary*

SOUTHERN CALIFORNIA SECTION

A meeting of the Southern California Section was held February 8, 1938, with an attendance of forty-five. The speaker of the evening, Lloyd Symmonds of the Institute of Finance and Business Economics, presented a discussion of current financial conditions and problems. The address evoked much interested discussion and gave the audience considerable food for thought.

The following officers were elected for the year 1938:

Chairman: T. S. CURTIS, Huntington Park, Calif.
Vice-Chairman: H. R. GOODRICH, Glendale, Calif.
Secretary-Treasurer: F. A. MCCANN, Pasadena, Calif.

Elwyn L. Maxson, whose untiring efforts have done so much to provide sparkle and entertainment for the Southern California Section, has been given the chairmanship of the Entertainment Committee for the current year. Mr. Maxson closed out a year of unusual activity as Chairman with a widely diversified series of programs.

—THOMAS S. CURTIS, *Ex-Corresponding Secretary*

CENTRAL OHIO SECTION

Members of the Central Ohio Section met on March 10, 1938, at the Engineering Experiment Station, Ohio State University. The speaker was G. A. Bole, director of ceramic research at the Experiment Station, whose subject was "An Evening of Research."

Dr. Bole discussed the various research programs under way at the Ohio State Engineering Experiment Station and directed an inspection tour of the various laboratories where many new and excellent pieces of ceramic research equipment are on display. The talk was supplemented with moving pictures showing several ceramic enterprises in which the ceramic research staff at the Station has played an active part; for example, the winning and processing of nepheline syenite.

—MYRIL C. SHAW, *Chairman*

BALTIMORE-WASHINGTON SECTION

The Baltimore-Washington Section held its winter meeting at Tilden Gardens in Washington on February 12. Despite the dense fog and inclement weather fifty members and guests were in attendance.

Dinner was served at 7:30 P.M. followed by a short business meeting with G. H. Spencer-Strong, Chairman, presiding.

An interesting talk on "Problems of the Present-Day Art Potter" was delivered by H. R. Bacher of Rock Tavern, N. Y. Mr. Bacher is considered to be one of the foremost art potters having exhibited in all exhibitions of note both in this country and in Europe. He is especially noted for his reproductions of Chinese reds. Mr. Bacher showed a number of colored slides and also had several pieces of ware on display. His talk, slides, and ware aroused considerable comment and discussion.

Owing to the general interest of the subject matter, a special invitation had been issued to the ladies, and a number of them graced the meeting with their presence.

The lecture was given in the chemistry lecture room at the National Bureau of Standards.

—JAMES D. TETRICK, *Secretary-Treasurer*

Valuable bibliographies and a complete Ceramic Book List are in preparation, in addition to the regular monthly publications. The Supplement to the Equilibrium Diagrams was issued April 1, 1938.

STUDENT BRANCH ANNUAL REPORTS

UNIVERSITY OF NORTH CAROLINA

The University of North Carolina Student Branch has a membership of 34 active and 29 associate members. A total of 20 new members has been enrolled during the year.

The society held nine regular monthly meetings during the year. Some of the most interesting meeting programs have been motion pictures. Among these were "The Manufacture and Installation of Vitrolite," "The Story of the Spark Plug," "The Use of Explosives," and "The Movement of Electrons in the Formation of Molecules." Several excellent speakers have been obtained for the meetings. At the opening fall meeting, Blake R. Van Leer, new dean of the engineering school, talked on "The Future of the Engineering School at the University." Dean Van Leer is one of the leading advocates for the 5-year plan of engineering education. Among the other speakers were James Peden, president of the Raleigh Engineer's Club; A. F. Greaves-Walker, head of the Department of Ceramic Engineering; and J. L. Stuckey, head of the Department of Geological Engineering.

Last spring, the Student Branch took part in the annual Engineer's Fair. An exhibit of art pottery made by its members won the Grand Prize for the best exhibit at the Fair. In April, a luncheon was given in honor of Ross C. Purdy, who was in Raleigh for a short time.

Along with the North Carolina Chapter of Keramos, the society has set up a loan fund for needy upperclassmen in the Department of Ceramic Engineering. A certain amount is to be contributed to the fund each year.

At the end of the last school year, the Student Branch held its annual outing in the form of a picnic. Members attended this very enjoyable affair practically 100 per cent.

Four seniors from the Ceramic Department attended the Annual Meeting of the American Ceramic Society in New York.

The officers for the past year have been *President*, Addison Maupin; *Vice-President*, J. P. Sawyer; *Secretary*, Frank P. Sabol; *Treasurer*, Charles D. King; *Member of Engineer's Council*, John J. Amero; *Alternate Member of Engineer's Council*, H. S. Gibbs; and *Faculty Adviser*, A. F. Greaves-Walker.

—ADDISON MAUPIN, *President*

GEORGIA SCHOOL OF TECHNOLOGY

Since the 1937 annual report of the Georgia Tech Student Branch, a comprehensive program has been carried out by this organization. On May 15, 1937, the Branch staged the first annual Ceramic Carnival which was attended by 150 invited guests. The invitations were of sheet-iron enamel. For the entertainment of guests, the members prepared enameled ashtrays bearing the Georgia Tech seal, attractive pottery vases glazed in brilliant colors, "money-bags" filled with ceramic "coins" of red, blue, and black "denominations," and "death-masks" of each member to provide the eerie effect for the "horror chamber." Each guest on arriving was presented with a bag of "money" which he was to spend on the various shows. These consisted of the "horror chamber," which displayed the "death-masks," illuminated by ultra-violet light on their oiled surfaces, a brilliant display of fluorescent minerals, and other materials. Other exhibits included a red-hot kiln, a demonstration of throwing on the potter's wheel and jiggering of whiteware, a microscope "peep-show," a picture-show on "The Making of Pottery," a demonstration of casting, and the firing of enameled ash trays with the signature of each guest. Each visitor "won" a piece of pottery in a raffle. Refreshments were served on the lawn. The Carnival was declared a tremendous success by all who visited it.

Speakers in the spring of 1937 included R. G. McKinstry, Hazel-Atlas Glass Co., who spoke on "Glass Tanks"; and T. T. Tucker, Armor Insulating Co., who spoke on "Glass Wool and Textiles"; student speakers were Emory Clark, "Refining of Georgia Kaolin"; R. B. Williams, "Pyrophyllite and Its Uses"; and Jo Teague, "Glass." The final spring meeting was climaxed by a steak supper at a member's home.

All students were employed in ceramic work during the summer.

The fall semester was opened with election of officers as follows: *President*, H. B. Grace; *Vice-President*, Darroh Nowell; *Secretary*, R. B. Williams; and *Treasurer*, M. J. Scavens.

The new men were welcomed at a weiner roast in the Ceramic Engineering Building. They were initiated into the Branch at a campus ceremony followed by private induction.

The members aided in staging an exhibit at the Southeastern Fair and in preparing the souvenir vases commemorating Atlanta's Centennial which were distributed there.

Speakers since the opening of school have been John Napier, senior student, "Sewer Pipe Manufacture"; A. V. Henry, head of the Ceramic Engineering Department, "History of the American Ceramic Society"; W. H. Vaughan, of the departmental staff, "Future of the Ceramic Engineering in the South"; E. B. Flowers, The Warren Co., "Enamels"; W. H. Kennedy, Armor Insulating Co., who spoke on "Glass Wool Manufacture" and showed a film on the same subject; and John Olden, Johns-Manville Corp., "Insulation," and showed a film, "Heat." The Branch attended a joint meeting with the architectural students at which a picture was shown by the Libbey-Owens-Ford representative on "Structural Glass Manufacture, Testing, and Installation."

The Branch visited the plant of the Atlanta Terra Cotta Company and were shown through by H. D. Hurlbut.

The Branch also visited the meetings of the Tile and Mantle Contractors Association Convention in Atlanta. John R. Kauffman of Rutgers University, attending this Convention, spoke to a special meeting of the Branch on "Testing of Tile."

The Branch now numbers twenty-five members of which ten are Student Members of the American Ceramic Society. The dues are 25 cents per meeting plus $1.00 initiation fee. This money goes to payment for a picture in the school annual, cost of entertainment at social affairs, and development of projects. W. H. Vaughan acted as councillor last year and Lane Mitchell has been councillor this year.

Plans are now being made for the presentation of the Charter to the Branch by Ross C. Purdy and Emerson Poste sometime in the spring. It is hoped to have a banquet for the formal presentation followed by the second Ceramic Carnival. The next meeting is to be a social function at which members will entertain their "dates" on a straw ride and picnic.

—LANE MITCHELL, *Councillor*

UNIVERSITY OF SASKATCHEWAN

Five technical papers have been presented by the following members of our Society*: (1) "The Gypsum Industry: Parts I and II," by V. C. Howie; (2) "Saskatchewan Bentonite," by W. G. Worcester, head of the Ceramic Department; (3) "Forced Draft," by S. Matthews; (4) "The Lead-Pencil Industry," by J. L. Ellis; and (5) "Ceramics and Road Materials," by H. C. Priest.

At their annual "Lab. Night," the Society entertained parents and friends with a program of ceramic demonstrations, competitions, and refreshments. Each guest received a novel ceramic souvenir. Lovely hand-turned vases were awarded to the major prize winners.

During the latter part of February, the Ceramic Society coöperated with the other branches of the Engineering College to present a demonstration of the various phases of work and experiments being carried on in the college. The public at large was invited to this instructive and entertaining program.

—V. C. HOWIE, *Secretary*

* Papers which were presented up to the close of the Student Branch activities will be listed later.

VIRGINIA POLYTECHNIC INSTITUTE

The V.P.I. Student Branch takes this opportunity to report its activities during the present school year.

The officers of the V.P.I. elected for 1937–1938 are *President*, A. M. Harvey; *Vice-President*, T. C. Vaughan; *Secretary*, R. G. Charles; and *Councillor*, J. W. Whittemore.

During the past year, the Student Branch has grown from a membership of 15 to 28 active members, and it is hoped that the Student Branch will continue to grow.

Meetings are held on the first and third Thursdays of each month. The program usually consists of an informal talk by one of the juniors or seniors who is a member of the Student Branch. The talks are usually illustrated by slides.

At the outstanding meeting of this year, a movie on "Refractories" was presented by the Harbison-Walker Refractories Company. The Student Branch was joined at this meeting by students in several other engineering organizations on the campus.

During the latter part of April, the annual "Tech Day" will be held. On this day, the Virginia Polytechnic Institute is host to approximately 600 high-school seniors from Virginia and neighboring states. Arrangements will be made for displaying ceramic engineering exhibits. Plans will also be made for more extensive exhibitions to be displayed on Engineers' Day during Commencement Week in June.

—R. G. CHARLES, *Secretary*

UNIVERSITY OF ILLINOIS

The first semester of 1937–1938 has been very active for the Student Branch of the University of Illinois. A summary of the activities and business of the Branch for the past semester is given:

The officers of the Branch are *President*, Warren R. Johnson; *Vice-President*, Merlin Whitehead; *Secretary*, Charles Hanks; and *Treasurer*, R. Zeller. The executive board has the following members: W. R. Johnson, L. J. McCleish, George Zink, John Hester, Paul Buckles, J. E. Freiss, and P. M. Wheeler.

The initial meeting of the year was held on October 14, and James Vanderpool gave an illustrated lecture on "Byzantine Mosaics." All Branch officers and faculty members were introduced and spoke briefly to the new members. At this meeting the results of the membership drive were announced, and a record membership of 112 was established.

On November 2, a smoker was held at the Kappa Sigma fraternity house. Captain McNutt of the R. O. T. C. staff talked on his experiences in Mexico while on active duty there. Considerable interest was shown by the members in regard to brick and pottery manufacture there.

The last meeting before the Christmas holidays was held on December 22, with the main attraction being movies of American pottery, which gave operations at the Lenox and Onondaga potteries. At this meeting, considerable business was transacted, including a treasurer's report and year-book and Ceramic Ruckus plans.

On January 12, A. E. Badger, research assistant in the local department, gave an illustrated lecture on "My Recent Experiences in Germany." Mr. Badger spent the past year studying in that country. Movies of the recent senior inspection trip to northern Indiana and Chicago were shown by A. I. Andrews.

The most important meeting of the year was held on January 18, when the Branch was proud to present Robert B. Sosman, President of the American Ceramic Society, as the speaker. Dr. Sosman gave a lecture on "Silicates as an Aid to Pyrometry," and it was enthusiastically received by the largest turnout of the year.

On February 10, R. S. Bradley, director of research at the A. P. Green Firebrick Co., Mexico, Mo., showed several reels of interesting film on plant procedure in firebrick manufacture.

On February 15, Rexford Newcomb, Industrial Publications, Inc., gave a survey of his experiences in the ceramic field since his graduation.

Some of the activities of the year have been (1) issue of *Raw Materials*, a weekly news sheet; (2) sponsorship of the "Ceramic Ruckus," a major campus dance; (3) in-

tramural athletics, including basketball and handball; (4) contributions to ceramic publications; (5) work on year book, The Illini Ceramist; and (6) work on enameled ashtrays to be presented as a symbol of branch membership.

Among the events scheduled for this spring are the following:

(1) Second departmental year book, The Illini Ceramist.

(2) Presentation of the annual "Pig Roast," a banquet and final meeting of the year.

(3) Meetings, with the following speakers;

March 8: Karl Kautz, Republic Steel Corp., Massillon, Ohio.

April 5: F. E. Hodek, Jr., General Porcelain Enameling Co., Chicago, Ill.

April 27: Charles Henderson, Alton Brick Co., Alton, Ill.

May 3: J. L. Essex, Illinois Clay Products Co., Chicago, Ill.

—WARREN R. JOHNSON, *President*

OHIO STATE UNIVERSITY

The regular monthly meeting of the Student Branch was held on March 9 at Lord Hall, Ohio State University. A demonstration of throwing on the potter's wheel was given by Arthur E. Baggs, Department of Fine Arts.

—JAMES WILLIS, *Secretary*

CERAMIC SCHOOL NOTES

SUMMER COURSES IN CERAMICS AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY

The Massachusetts Institute of Technology has announced two special summer courses in Ceramics, *viz.*, (1) The Nature of Glass, July 11–16, 1938, and (2) Reactions in Ceramic Materials on Heating, July 18–23, 1938. These courses are offered by the Department of Metallurgy and are under the auspices of the Committee of the Summer Session.

(1) The Nature of Glass

It is only within the last two decades that a reasonable picture of the structure of glass has been presented. At first this picture was very indistinct, but every year it has become clearer and clearer, until today it stands out sharply in the main outlines even though vague in many details. It is the purpose of this course to present this picture as it looks to a number of workers who see it from different points of view. The proposed schedule is as follows:

July 11

(1) "Introduction to the Course," by F. H. Norton, Massachusetts Institute of Technology.

(2) "Nature of Glass as Interpreted by X-Ray Studies, I," by B. E. Warren, Massachusetts Institute of Technology.

July 12

(3) "Nature of Glass as Interpreted by X-Ray Studies, II," by B. E. Warren.

July 13

(4) "Nature of Glass as Interpreted by Light Absorption," by W. Weyl, Pennsylvania State College.

July 14

(5) "Nature of Glass as Interpreted by Its Viscous Properties," by H. R. Lillie, Corning Glass Works.

July 15

(6) "Nature of Glass as Interpreted by Devitrification," by H. H. Blau, Corning Glass Works, Charleroi Div.

July 16

(7) "Nature of Glass, a Summary," by G. W. Morey, Geophysical Laboratory, Carnegie Institution of Washington.

The following laboratory experiments, designed primarily to familiarize the student with modern apparatus for measuring the properties of glass, will be made available: (*1*) *Expansion:* the expansion curve of a glass is determined up to its softening point with a newly developed furnace of high precision; (*2*) *viscosity:* the viscosity of a glass is measured near the transformation point by the fiber method; (*3*) *color:* the transmission properties of a number of glasses are measured on the Hardy spectrophotometer; (*4*) *devitrification:* the nuclear formation and crystal growth rate are illustrated by controlled heat treatment; and (*5*) *X-ray powder pattern:* a picture is taken of a typical glass to illustrate the use of the equipment for this purpose.

(2) Reactions in Ceramic Materials on Heating

Probably the least understood and most bothersome phase in the manufacture of ceramic articles is the firing operation. While a great deal of knowledge has been accumulated in this field, it has not been given that detailed consideration accorded, for example, to the heat treatment of metals. It is the purpose of the following program to bring out what information is available from several points of view and to point the way for further progress. The proposed schedule is as follows:

July 18

(1) "Introduction to the Course," by F. H. Norton.

(2) "Measurement and Control of Temperature," by G. B. Wilkes, Massachusetts Institute of Technology.

July 19

(3) "Equilibrium Diagrams and Their Interpretation," by G. W. Morey.

July 20

(4) "Effect of Heat on Clay," by Herbert Insley, National Bureau of Standards.

July 21

(5) "Reactions Occurring in a Whiteware Body on Heating and Cooling," by F. P. Hall, Onondaga Pottery Company.

July 22

(6) "Reactions Occurring in Refractories on Heating and Cooling," by R. B. Sosman, U. S. Steel Corporation.

July 23

(7) "Reactions between Glazes and Bodies on Heating and Cooling," by F. H. Norton.

The following experiments will be made available: (1) standardization of pyrometers; (2) thermal analysis of clays; (3) weight loss of clays on heating; (4) measurement of glaze stresses; and (5) effect of heat treatment on glaze.

Requests for information regarding this program should be addressed to F. H. Norton, Dept. of Metallurgy, Massachusetts Institute of Technology, Cambridge, Mass.

FIFTH CONFERENCE ON GLASS PROBLEMS

University of Illinois, May 20 and 21

A Fifth Conference on Glass Problems will be held at the University of Illinois, May 20 and 21. The topics to be discussed are batch mixing, batch handling, and molds. The first conference of this kind was in 1934 and each has been successful. The purpose of these conferences is to provide a forum for all who are interested in glass plant problems. The proposed 1938 Conference has been planned in response to requests received from numerous persons who have attended previous sessions. Those interested in obtaining detailed information should write to the Department of Ceramic Engineering, University of Illinois, Urbana, Ill.

J. A. PASK, DEPARTMENT STAFF ASSISTANT

The Department of Ceramic Engineering, University of Illinois, announces the appointment of J. A. Pask to the staff as assistant. Mr. Pask was graduated from the Department in 1934 and was appointed Fellow on a coöperative investigation conducted by the University of Washington and Northwest Experiment Station, U. S. Bureau of Mines. In 1935, he received the M.S. degree in Ceramic Engineering from the University of Washington. He was then employed as ceramic engineer for the Willamina Clay Products Co., Willamina, Ore. During the summer of 1936, he was with the Northwest Experiment Station, U. S. Bureau of Mines, as petrographer. In September 1936, he was appointed as a research graduate assistant in the University of Illinois Engineering Experiment Station and assigned to the Department of Ceramic Engineering. He has not been appointed to the teaching staff.

NECROLOGY

PERCY WITTER BURDICK*

Percy Witter Burdick, youngest son of a family of five children of Harriet Francelia Witter and James Tracy Burdick, was born June 7, 1890, at Friendship, N. Y., and died at Niagara Falls, February 25, 1938, following an operation.

The earlier years of Mr. Burdick's life were spent in and around Friendship, the home of his parents. Here he attended the Union School and assisted his father, who in those days was a distinguished painter and decorator. When about sixteen he, with his parents, took up their residence in Wellsville at the "Well-ville" Sanitarium, then owned and operated by Dr. and Mrs. Virgil C. Kinney; Mrs. Kinney was his sister and the youngest daughter in the family. Here he and his mother became able assistants.

He attended the Wellsville High School from which he was graduated in the summer of 1908.

In September, 1911, he entered Alfred University as a freshman, graduating with a class of thirty in 1915, majoring in scientific ceramics. He was an Orophilian and belonged to the Clan Alpine and Burdick Hall clubs. While in college, he was active in the various class athletics, captain of class track, vice-president of the Athletic Association his third year, and secretary and treasurer of the N. Y. Ceramic Society during the same period. In college, he was familiarly known as "Pat," and the name stayed with him down through the years.

Leaving college he secured a position in the Carborundum plant at Niagara Falls.

Percy W. Burdick

Entering the World War, he was sent to France with the Sanitary Department of the 23rd Engineers, and stationed

* *The Alfred Sun*, Alfred, Alleghany County, N. Y., March 3, 1938.

at St. Mihiel (Mense) with the American Sanitary Service. Before returning to his native land, he sought the hand of Miss Madeleine Baar, a French maiden of culture and refinement. They were married May 27, 1919, and sailed for America. Joyous was his home coming with his new bride, who soon became a much loved member of his family.

Not many months after their arrival, he returned to the Carborundum Company, where he remained a valuable and faithful employee until the last few days of his fatal illness.

Mr. Burdick was a man of fine character, resolute and somewhat reserved. He greatly loved his home and family and was an indulgent husband and father, manifesting unusual interest in the advancement of his children in the essential things of life.

He leaves his widow, Madeleine, a daughter, Mary Madeleine, a son, Robert Baar, two sisters, and a brother.

Services were held in their home Sunday evening, February 27. On Monday, the funeral cortège wended its way back to the "little old church" at Nile, which he attended in his boyhood days.

Covered with the flag of his country, his silent body found its last resting place on the crest of Mt. Hope in Friendship to lie among those he had "loved and lost awhile."

Mr. Burdick had been a member of the American Ceramic Society since 1920.

NEW MEMBERS

Corporation

RANSOME CONCRETE MACHINERY CO., L. R. Wilson (voter), Dunellen, N. J.

Personal

ANKENY, C. W., 205 West Wacker Drive, Chicago, Ill.; district manager, Hardinge Co., Inc.

BALCOM, PHILIP D., 124 Greenleaf St., Quincy, Mass.

*DURBIN, Edmund A., Champion Spark Plug Co., 8525 Butler Ave., Hamtramck, Mich.

EVANS, ELMER H., Observer Press Assn., Oshkosh, Wis.; president.

FERGUSON, WILBUR R., 1390 Meadow Rd., Columbus, Ohio; research engineer, Battelle Memorial Institute.

*GATES, MAJOR E., Crystal Lake, Ill.; Illinois Clay Products Co.

GULICK, CHESTER, 294 Spring St., Trenton, N. J.; ceramic engineer, Star Porcelain Co.

KAUFFMAN, THEODORE, JR., 2563 West 18th St., Chicago, Ill.; manager, The Ramtite Co.

KNECHT, ALBERT O., 417 Sheridan Ave., New Castle, Pa.; ceramic engineer.

KOCHER, DANIEL W., 128 Cedar St., Mount Union, Pa.; ceramic engineer, North American Refractories Co.

NETZEBAND, F. F., 1905 Pennsylvania, Joplin, Mo.; air hygiene engineer, Tri State Zinc & Lead Ore Producers Assn.

OLSON, HJALMAR, A. B. Gustavsbergs Fabriks, Intressenter, Gustavsberg, Stockholm, Sweden.

PHELPS, NELSON G., 1060 National Press Bldg., Washington, D. C.; eastern representative, Allied Engineering Co.

ROGERS, EDWIN J., 505 King Ave., Columbus, Ohio; research engineer, Battelle Memorial Institute.

* Indicates former member of the Society rejoining for 1938.

Student

GILBO, CHARLES F., New York State School of Ceramics.

HENRY, GEORGE R., Pennsylvania State College.

MEMBERSHIP WORKERS' RECORD

Corporation

Office	1

Personal

C. R. Austin	1	E. P. McNamara	1
J. R. Beam	1	A. S. W. Odelberg	1
G. H. Brown	2	J. D. Sullivan	1
F. E. Finch	1	H. E. White	1
C. E. Heinz	1	Hewitt Wilson	1
		Office	3

Student

R. M. Campbell	1	E. C. Henry	1
		Grand Total	**17**

FORTY-FIRST ANNUAL MEETING AMERICAN CERAMIC SOCIETY

Chicago, Illinois, 1939

GENERAL SUMMER MEETING

San Francisco, Calif., 1939

CERAMIC EXPOSITION

New York, 1939

Here Is the First Quarter Record

All resignations have been subtracted.

Next month all unpaid for 1938 will be counted out. There are (on March 18) 137 who have not paid. This number is being reduced each day.

What will the April record show?

That depends on you.

"Recession" in support of ceramic science is expected to follow recession in incomes, but will it?

That also depends on you.

MEMBERSHIP RECORD

Date of Record	Members Paid		Deferred	Subscriptions	Monthly Sales	Total Circulation
	Personal	Corporation				
December 20, 1936	1452	196				
December 22, 1937	1713	220	12	523	220	2688
January 22, 1938	1712	220	12	530	220	2694
February 18, 1938	1728	217	15	540	220	2720
March 18, 1938	1770	216	10	513	220	2729

All resignations have been subtracted. Only those having "cash on the counter" are counted. Those not fully paid by March 15 will be cut off. Will *you* allow a shrinkage in the number of *your* coöperators?

NOTES AND NEWS

CERAMIC ASSOCIATION OF NEW JERSEY

At the 1937 Annual Meeting of the Ceramic Association of New Jersey, the following officers were elected for the year 1937–1938:

President: J. M. STANGL, Fulper Pottery Co., Flemington, N. J.
Vice-President: G. C. CROSSLEY, United Clay Mines Corp., Trenton, N. J.
Councillor: AUGUST STAUDT, Perth Amboy Tile Works, Perth Amboy, N. J.
Secretary-Treasurer: G. H. BROWN, Dept. of Ceramics, Rutgers Univ., New Brunswick, N. J.
Asst. Secretary: E. L. NAWROT, Dept. of Ceramics, Rutgers Univ.

The following members were elected to the Executive Committee with terms expiring in December, 1940:

(1) Charles Brian, Paper Makers Importing Co., Easton, Pa.
(2) Alfred Mathiasen, Matawan Tile Co., Matawan, N. J.
(3) W. H. Kelly, Standard Sanitary Manufacturing Co., Trenton, N. J.
(4) T. H. McKeown, Roessler & Hasslacher Chemical Co., Perth Amboy, N. J.
(5) J. A. Schermerhorn, National Porcelain, Co., Trenton, N. J.
(6) G. T. Morse, U. S. Gypsum Co., was elected to fill the unexpired term on the Executive Committee of G. C. Crossley.

J. M. Stangl, *President*, Ceramic Association of New Jersey

George C. Crossley, *Vice-President*, Ceramic Association of New Jersey

CENTRAL DISTRICT ENAMELERS' CLUB

The Central District Enamelers' Club held a dinner meeting Thursday evening, March 24, in the Rainbow Room of the Carter Hotel, Cleveland, Ohio. Following the dinner J. E. Hansen, Service Director, Ferro Enamel Corp., spoke on "Pickling and Ground-Coat Practice," and Roy Beck, Porcelain Enamel & Mfg. Co., discussed "Enamel Shop Control Tests."

Membership in The American Ceramic Society
Means *Month-by-Month* Ceramic Progress

August Staudt, Councillor, elected December, 1937, Ceramic Association of New Jersey

AIR HYGIENE FOUNDATION ANNUAL BUSINESS MEETING*

Fifteen representatives of industry, science, and government were elected to the Board of Trustees of Air Hygiene Foundation at the annual business meeting held at Mellon Institute, Pittsburgh, on February 8. The Foundation is a nonprofit, coöperative organization for the advancement of industrial health.

H. B. Meller, Managing Director, announced in his annual report that 200 industrial plants are now supporting the Foundation's research and studies for the prevention of occupational disease. Meller said this basic work, "of vital human and economic import," is progressing at several research centers, including the Saranac Laboratory; the Moore School X-Ray Laboratory, University of Pennsylvania; and at Mellon Institute. Dr. Meller made the following statement:

"Aside from the intense human benefits involved, industrial health pays practical dollar-and-cents dividends to employers, employees, and to the community. It means (1) increased production, (2) increased efficiency and less absenteeism, (3) fewer compensation claims and damage suits, (4) improvement in home and community life, curtailing public welfare costs, and (5) better employer-employee relations and increased public good will.

"During the past year, six states passed laws compensating workmen for occupational diseases. Twenty-one states and the District of Columbia now have such laws. Eight other states are considering enacting this legislation. In the next few years all of the industrial states will probably have passed laws for this purpose. We must seek out stringent ways and means of curbing or controlling industrial diseases; otherwise industry and the community may be burdened with mounting compensation costs, to say nothing of the loss in earning and buying power of the affected workman and his dependents."

Members of the Board of Trustees, all of whom were reëlected, follow:

V. P. AHEARN, *Executive Secretary*, National Industrial Sand Assn., Washington, D. C.; VANDIVER BROWN, *General Attorney*, Johns-Manville Corp., New York; JOSEPH DILWORTH, *Assistant-to-President*, Westinghouse Electric & Manufacturing Co., Pittsburgh; ANDREW FLETCHER, *Vice-President*, St. Joseph Lead Co., New York, DAN HARRINGTON, *Chief, Health and Safety Branch*, U. S. Bureau of Mines, Washington, D. C.; ROGER A. HITCHINS, *President*, National Refractories Co., Philadelphia; E. A. HULTS, *Vice-President*, Mathieson Alkali Works, New York; C. E. LESHER, *Vice-President*, Pittsburgh Coal Co., Pittsburgh; B. D. SAKLATWALLA, *President*, U. S. Rustless Steel & Iron Corp., Pittsburgh; HENRY D. SAYER, Association of Casualty & Surety Executives, New York; Dr. R. R. SAYERS, U. S. Public Health Service, Washington, D. C.; H. A. SCHULTZ, *Assistant-to-Vice-President*, U. S. Steel Corp., Pittsburgh, Pa.; A. W. SHERWOOD, *Vice-President*, Owens-Illinois Glass Co., Toledo; LLOYD T. WILLIAMS, Williams, Eversman & Morgan, Toledo; and W. P. YANT, *Research Director*, Mine Safety Appliances Co., Pittsburgh.

BATTELLE MEMORIAL INSTITUTE RESEARCH ASSOCIATES

For the third consecutive year, four appointments as Research Associates are being made available at Battelle Memorial Institute, Columbus, Ohio. These appointments are open to graduates of any accredited college or university. Preference will be given to men who have demonstrated marked aptitude for scientific research in their industrial experience or by graduate study in chemistry, physics, metallurgy, or ceramics. Appointments as Research Associate will be for one year's duration, including vacation, and may be extended for a second year. The salary will be $1800 a year. Application forms and further information may be secured by writing to Clyde E. Williams, Director.

Maynard M. Baldwin has become a member of the chemical research staff of Battelle Memorial Institute, and has been assigned to fundamental research on organo-metallic compounds. Dr. Baldwin was formerly research assistant at Pennsylvania State College, Mineral Industries Experiment Station.

The facilities of the Ceramic Division at Battelle Memorial Institute, Columbus, Ohio, have been expanded to care for the increased demand for industrial research in ceramics and refractories. Recent additions to the technical staff include W. R. Ferguson, A. J. Metzger, and M. S. Tarnopol.

* For a detailed report of the Annual Meeting of the Air Hygiene Foundation, see *Bull. Amer. Ceram. Soc.*, **17** [1] 39–40 (1938).

RESEARCH FELLOWSHIPS IN COAL AND NONMETALLICS

The University of Washington offers four fellowships for 1938–1939 in the College of Mines for research in coal and nonmetallics in coöperation with the United States Bureau of Mines. Fellows enter upon their duties on July 1, 1938, and continue for 12 months. Payments amount to $720 for the year. Applications will be passed upon late in April.

The nonmetallics problems listed are studies on kaolin, talc, soapstone, olivine, silica-sand, diatomite, and other nonmetallics.

TOLEDO MUSEUM OF ART

A contemporary decorative art exhibit was held at the Toledo Museum of Art, Toledo, Ohio, from February 6 to 27.

In the field of ceramics, a large group came from Cleveland, where there are many talented workers. A number of fine pieces were made in the Department of Fine Arts of Ohio State University, and the Pewabic Pottery of Detroit was represented by several examples showing remarkable metallic glazes. Four outstanding pieces of ceramic sculpture were the work of Waylande Gregory of New York.

Most of the exhibitors have been represented in the exhibition sponsored by the American Ceramic Society in 1937 for the Scandinavian countries and in the annual Robineau Memorial Exhibition at Syracuse, as well as other important showings.

A less familiar medium, that of colored enamel on metal, was shown in the works of H. Edward Winter, Russell Barnett Aitken, and Kenneth Francis Bates, all of Cleveland.

That glass of good design may be produced in large quantities for everyday use was demonstrated by the examples chosen from the productions of four manufacturers of this vicinity. The Libbey, Cambridge, Heisey, and Duncan and Miller plants, all producing ware of high quality and interesting design, were represented.

The members of the American Ceramic Society who were exhibitors were Edgar Littlefield, Alice A. Ayars, Arthur E. Baggs, H. E. Winter, W. B. Stratton, Mary Chase Stratton, and Mrs. A. R. Dyer.

FIRST CALIFORNIA CERAMIC EXHIBITION

The First California Ceramic Exhibition opened on March 3, 1938, at the Los Angeles Museum. There were 52 exhibitors and 109 pieces shown. Roger Hollenbeck has reviewed this Exhibition and excerpts of his story are given here.

"This Exhibition means that the Pacific Coast ceramic child is able to walk alone. For some time California has been recognized as a rising force in ceramic contribution.

"Pottery manufacturers have used the State's romance and color in producing more or less attractive ware, the recent vogue for which we may thank for a wide ceramic interest and enthusiasm. It is the work of California studio potters, as distinguished from these larger concerns, that makes up this Exhibition. But these potters are not basking in the light of the vogue alone; they are ready for the first time to exhibit as a State.

"In this Exhibit, there is more than a state or craft achievement. It means triumph for infant studios from San Francisco to San Diego. The uninitiated can not imagine the great expense of kilns and other equipment, the greater trial of making a small plant self-supporting. Let these things serve as an introduction to your greater enjoyment if you respond to art as close to the hand as the potter's.

"The number of ceramic sculptures is surprising. This expression, whether large or small, serious or whimsical, colorful or neutral, is sensible and stimulating decoration for modern livable homes. We may hope that the time of nondescript art objects is passing, that products of this kind may take their place.

"Technical knowledge of glaze and clay, form, and pattern do not make a potter. It is the awareness of now that makes contemporary pottery stimulating. It runs along with the times, never ahead, sometimes behind."

Glen Lukens, of the University of Southern California and a member of the Art Division of the American Ceramic Society, has contributed a group of pieces which "reminds one that fundamental form and glaze quality surpass trends in smartness; they are always contemporary." Work of Mr. Luken's students was also exhibited.

Viewed as a whole, one finds that California color, thought, and design are more American than anything else. The Exhibition is comparable to, though not as stimulating, as last year's more widely chosen National Ceramic Exhibition. It forecasts a bright future for California ceramics.

ALL-OHIO CERAMIC EXHIBIT

An All-Ohio Ceramic Exhibit was presented at the Butler Art Gallery in Youngstown, Ohio, from March 4 to March 27, by the Junior League of Youngstown.

THIRTY-EIGHTH ANNUAL EXHIBITION OF NEW YORK SOCIETY OF CERAMIC ARTS

The New York Society of Ceramic Arts held its Thirty-Eighth Annual Exhibition in New York, N. Y., from March 8 to March 19. This Society was founded some forty years ago, one of the first organized bodies of craftsmen in this country. From that time it has consistently fostered the art of ceramics and assisted in the development of the individual ceramic worker. It has also, during all these years, made possible an annual exhibition of the workers in this field.

The present show is made up of examples from the kilns of most of the representative workers in this field in America.

Mrs. Luke Scott Backus sent a number of interesting pieces, decorated and undecorated. Glen Lukens was represented by excellent examples of his glaze research work. Henry Varnum Poor showed his usual type of work in a large plaque. The contributions of Miss Maud Mason

included small sculptures in a turquoise glaze and large vases modelled and carved.

Among the exhibitors were Edwin Pearson, J. Milton Robertson, Wheeler Williams, M. Grotell, Mrs. Mabel Nestler, Mrs. Jessie A. Stagg, Luther Richardson, Edris Eckhardt, Roberta Leber, Carrie Teale Swartz, Robert H. Rockwell, Leonora Nichols, L. P. Kelsey, Martha Davis, Franz von Lurg, and Dedham Pottery.

CHARLES S. PEARCE SECRETARY OF PORCELAIN ENAMEL INSTITUTE

Frank E. Hodek, Jr., President of the Porcelain Enamel Institute, Chicago, has announced the appointment of Charles S. Pearce as Secretary to fill the position vacated by G. P. MacKnight.

Charles S. Pearce, Secretary, Porcelain Enamel Institute

Mr. Pearce started his industrial career with the Weirton Steel Co., Weirton, Va., in 1918. He left there in 1920 to attend college, and was graduated from Ohio State University in 1924, after specializing in industrial management. During his college years, Mr. Pearce was employed for a short time with the Foundries Division of the Jones & Laughlin Steel Corp., at Pittsburgh, Pa.

Immediately after leaving Ohio State, he entered the employ of the Tennessee Furniture Corp., Chattanooga, Tenn. This company at that time was producing some of the first all-porcelain enameled refrigerators and specializing in the development of the one-piece porcelain enameled liner.

In 1926, Mr. Pearce joined the Budgetary Control Division of the Frigidaire Corp., Dayton, Ohio. In the next four years he held various office and factory positions with that company. In 1930, he was made head of the Porcelain Enameling Department, at that time the largest wet-process enameling plant in the United States.

Mr. Pearce left this position early in 1935 to head up the enameling operations of the Davidson Enamel Co., at Clyde, Ohio.

In the fall of 1935, he joined the Farm Security Administration as Assistant Director of Personnel, which position he leaves to assume his new duties.

In selecting Mr. Pearce as Secretary, the officers point to his wide range of experience in the manufacture of porcelain enamel as eminently fitting him to serve the industry through the facilities of the Porcelain Enamel Institute.

CHICAGO DISTRICT ENAMELERS' CLUB

A meeting of the Chicago District Enamelers' Club was held in Chicago, Ill., on March 12, 1938, at the Graemere Hotel. The following papers were presented:

(1) "Stabilization of the Reflectance and Color of Re-Coat Enamels," by G. H. McIntyre, Director of Research, Ferro Enamel Corp., Cleveland, Ohio.
(2) A motion picture presented by the Youngstown Sheet & Tube Co., Youngstown, Ohio.
(3) "Application of the Wheelabrator to Enameling Plant Cleaning Problems," by E. B. Rich, American Foundry Equipment Co., Mishawaka, Ind.

The Program Committee is as follows: M. E. Manson; *Chairman*, Chicago Vitreous Enamel Product Co., Cicero, Ill.; N. P. Alessi, American Stove Co., Harvey, Ill., D. W. Armstrong, Benjamin Electric Mfg. Co., Desplaines, Ill.; and G. W. Hofstetter, Rohm & Haas, Philadelphia, Pa.

OHIO STATE CHAPTER OF KERAMOS HOLDS DINNER MEETING

The year's activities commenced with a dinner meeting at the Dutch Tavern in Columbus, Ohio, on February 24, 1938. Following the dinner, President Farenbruck formally welcomed Arthur E. Baggs, Chairman of the Ceramic Arts Department, as an Honorary Member of Keramos. He was not formally initiated but, instead, will attend the formal initiation during the Spring Quarter when student members are initiated.

Prospective members were entertained. These members were selected on the basis of scholastic attainment and will be passed upon by the active Chapter.

Tom Faulkner and Nick Carter gave brief talks on what Keramos means to the ceramic student. Others in attendance outside of the active Chapter were Ross C. Purdy, A. S. Watts, R. M. King, and J. L. Carruthers.

—Charles B. Tauber, *Secretary*

The Meeting in New Orleans was another record-breaker

ADDITIONAL ACTIVITIES OF THE SOCIETY

HONORARY MEMBERS ELECTED MARCH 31, 1938

Frederick Carder: Steuben Division, Corning Glass Works, Corning, N. Y.

Lucien Delloye: Retiring Director, Compagnie de Saint-Gobain, Chauny & Cirey, Paris, France

Mary Louise McLaughlin: 4011 Sherwood Ave., Cincinnati, Ohio

Colonel C. W. Thomas: E. J. & J. Pearson, Ltd., Stourbridge, England

Live Member

A. F. Hottinger, Northwestern Terra Cotta Co., Chicago, Ill.

FELLOWS ELECTED TO MEMBERSHIP FOR 1938

Albert Lee Bennett, Gladding, McBean & Co., Los Angeles, Calif.

Lawrence Herbert Brown, Hall China Co., East Liverpool, Ohio

Harry Dennis Callahan, U. S. Quarry Co., East Sparta, Ohio

George Herbert Duncombe, Jr., 150 E. Frambes Ave., Columbus, Ohio

John Otis Everhart, Kentucky Fire Brick Co., Haldeman, Ky.

George Postel Fackt, Gladding, McBean & Co., Los Angeles, Calif.

Raymond Albert Heindl, National Bureau of Standards, Washington, D. C.

Herbert Insley, National Bureau of Standards, Washington, D. C.

Victor Vivian Kelsey, 1403 Trenton Trust Bldg., Trenton, N. J.

Harold Siegrist Nash, Univ. of Cincinnati, Cincinnati, Ohio

Fred Benson Ortman, Gladding, McBean & Co., Los Angeles, Calif.

Karl Schwartzwalder, A C Spark Plug Co., Flint, Mich.

Ira Elmer Sproat, R. T. Vanderbilt Co., Westport, Conn.

Officers of Fellows, 1938–1939

Dean: Paul E. Cox, Iowa State College, Ames, Iowa

Associate Dean: W. Keith McAfee, Universal Sanitary Manufacturing Co., New Castle, Pa.

Secretary-Treasurer: R. K. Hursh, Univ. of Illinois, Urbana, Ill.

Fellows Inducted at the 1937 Meeting

Herbert Duane Carter, Canton Stamping & Enameling Co., Canton, Ohio

Harry Emmett Ebright, 17895 Lake Road, Lakewood, Ohio

Gordon S. Fulcher, Corhart Refractories Co., Louisville, Ky.

W. Raymond Kerr, Armstrong Cork Co., Beaver Falls, Pa.

John Francis McMahon, New York State College of Ceramics, Alfred, N. Y.

Frederick Harwood Norton, Massachusetts Institute of Technology, Cambridge, Mass.

Douglas Franklin Stevens, 801 W. Center, Danville, Ill.

Stephen M. Swain, North American Refractories Co., Cleveland, Ohio

Benjamin Joseph Sweo, Ferro Enamel Corporation, Cleveland, Ohio

Gordon Ball Wilkes, Massachusetts Institute of Technology, Cambridge, Mass.

OUR FORTIETH ANNUAL MEETING, NEW ORLEANS, MARCH 27 TO APRIL 2

Many there were who at the close of the Meeting said that this was one of the finest and most profitable the Society has yet held. Mail received at the Executive Office has carried many letters of appreciation and delight.

Registration at the Meeting was 379 men, 75 ladies, and 74 students; a total of 528. Several there were, as always, who did not register.

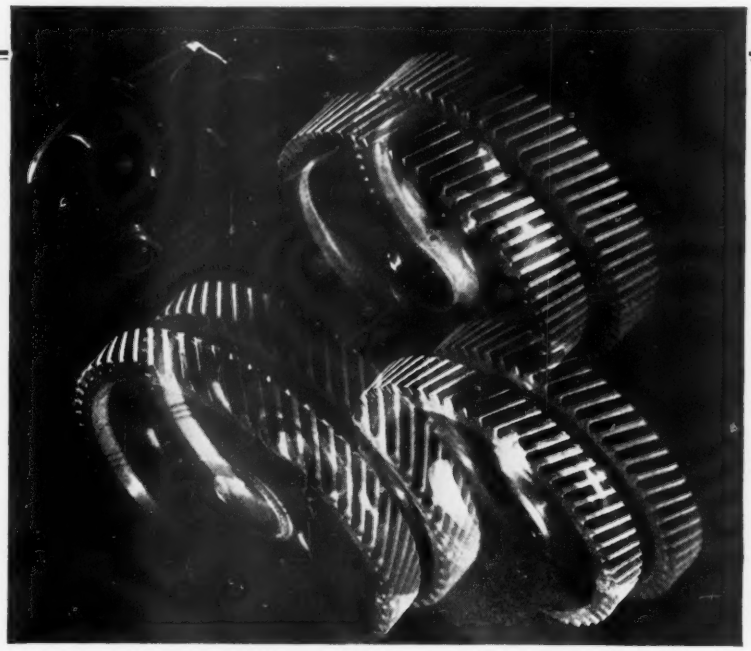
Expenses of the Meeting	$2759.10
Registration income	1453.94
Resulting in a loss of	$1305.16

Appreciations are due to Martha G. Westfeldt, Ralph H. Weston, and Kenneth Smith, our local members, and to R. A. Steinmayer and others who assisted in making the local arrangements. The entertainments on Sunday, Monday, and Tuesday nights were greatly enjoyed by all who attended them. These were exclusively by university talent and were high grade and unusual. The two teas especially arranged for the ladies were well attended and enjoyed.

The decisions of the Board of Trustees of last spring (1) not to permit local financing of the Meeting, (2) not to arrange special meetings of the ladies, other than teas at the galleries, University, and Mrs. Westfeldt's studio, (3) to give as much opportunity as possible without curtailing meeting schedules to visit the historical and noted places of New Orleans worked out advantageously for all.

The exhibits of Alabama, Georgia, Mississippi, New Jersey, North Carolina, and Tennessee were excellent, and commanded the interest of many.

The Meeting programs were rich and well attended. It was surprising to find that a large group was assembled in each of the meeting rooms promptly at 9:30 A.M.



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Calcspar
Chrome Oxide, Green
Clay, Vallendar
Cobalt Oxide, Black
Cobalt Sulphate
Copper Oxides
Iron Chromate
Iron Oxides
Kryolith
Lead Chromate
Magnesium Carbonate
Manganese Dioxide
Nickel Oxide, Black
Nickel Oxide, Gray
Nickel Sulphate
Potassium Bichromate
Potassium Nitrate
Potassium Permanganate
Powder Blue
Rutile, Powdered
Selenium
Sodium Aluminate
Sodium Antimonate
Sodium Bichromate
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Sodium Uranate
Tin Oxide
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Uranium Oxide, Orange
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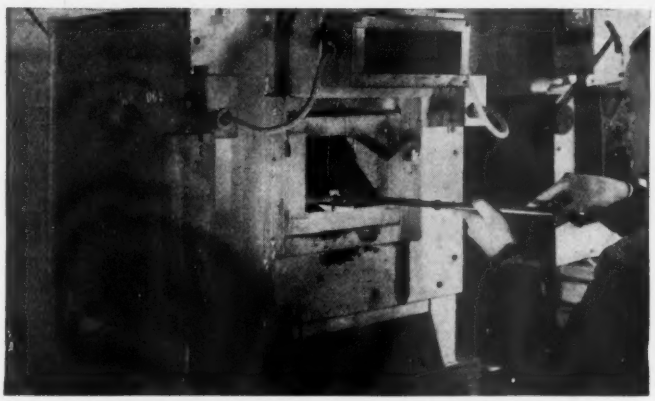
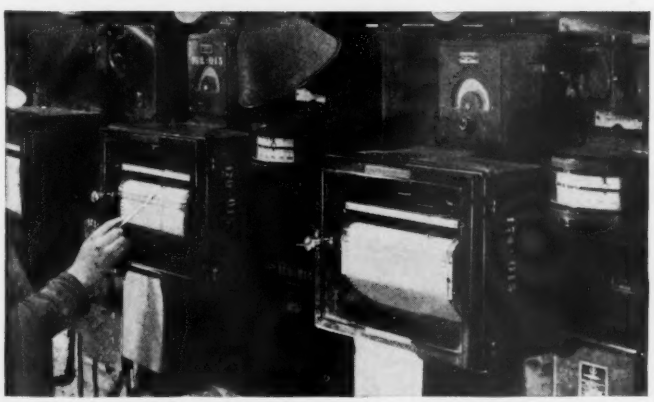


3 Sample tests for pottery colors are carried out by firing small pieces of tile in electric furnaces with controlled temperatures.



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Mr. Pete Potter,
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Dear Pete:

Well, we're home, the Battle of New Orleans fought and won again. A nice engagement, I call it! No casualties—a good attendance! They say General Jackson and his army, had a fine time, and so did the American Ceramic Society.

A lot of good papers this time. The potting industry, in the desire to progress, seems to be keen on new processes. One of our Past Presidents told me a story while at the Meeting about a farmer who, when he was urged to subscribe to a farm journal that the salesman said would keep him informed as to all new and better methods of farming, declined and said, "I ain't farming as good as I know how now."

Nothing produces business and profit in the ceramic industry like the best possible quality. Maybe we'd better start with our raw material deposits, our clay bins, and slip houses and go thru the whole process and make sure we are potting as good as we know how now, before we make too many changes.

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M and T

SODIUM ANTIMONATE

Every lot of M and T sodium antimonate must pass eleven exacting physical, chemical, and enameling tests before it is shipped from the factory.

These tests prove the absolute uniformity of both the product and its performance. They prove that M and T sodium antimonate is entirely free from chemical or physical variations—that it is always of the highest quality which selected raw materials, scientifically processed, can produce.

The many users of M and T sodium antimonate take no chances when they continually choose this superior product.

METAL & THERMIT CORPORATION, 120 BROADWAY, NEW YORK, N. Y.